SPECIFICATION MANUAL

of

PLAIN AND REINFORCED CONCRETE

PORTLAND CEMENT ASSOCIATION

SPECIFICATION MANUAL

OF

PLAIN AND REINFORCED CONCRETE

AND OTHER

WORK CONTAINING PORTLAND CEMENT

SUMMARY OF CONTENTS

	PAGE
Foreword	1
Preface: Introductory and explanatory notes	2
Specifications: Part I—General and Part II—Materials	
Index	4
Specifications	8
Part III—Construction	
Index	16
Specifications	26
Appendix I: Suggested Specifications for Strength Concrete	55
Appendix II: Special Recommendations in reference to certain paragraphs of Specifications	59
Appendix III: References to Specifications of the A. I. A. and the A. S. T. M.	61
Appendix IV: Coded Specifications	
Index	66
Coded Specifications	69

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Foreword

ENGINEERS, architects, contractors and others interested in building construction so frequently make inquiry of the Portland Cement Association for specifications on the use of concrete, that it suggested the assembling of the data in this manual as an aid to drafting general specifications. They record the progress that has been made in advancing the art and science of using concrete and also reflect the advantages and practicability of quality control in the field.

No one group or organization identified with the building industry can claim all credit for the assembly of rules of practice in this manual. On the contrary, credit is due to a number of organizations composed of engineers, architects, builders and others who, individually and collectively, have continuously contributed to advancing the science of concrete construction as expressed in written specifications. Among such organizations are:

American Institute of Architects
American Society of Civil Engineers
American Society for Testing Materials
American Railway Engineering Association
American Concrete Institute

It is believed that these specifications, to which the Portland Cement Association has contributed certain recommendations, represent the best prevailing guide for the use of concrete, plain and reinforced.

PORTLAND CEMENT ASSOCIATION

Chicago, May 1, 1924.

SPECIFICATIONS

FOR

PLAIN AND REINFORCED CONCRETE

AND

OTHER WORK CONTAINING PORTLAND CEMENT

Preface

THIS Specification Manual is intended to cover the field of plain and reinforced concrete construction and other work containing portland cement, such as portland cement stucco, mortar, et cetera.

The specification paragraphs are arranged as nearly as possible in the order of using. Care has been taken to avoid repetition and, where such occurs, it is only for the purpose of emphasizing important principles relative to obtaining first class results.

The specifications are divided into three main sections, namely: *Part I—General; Part II—Materials; Part III—Construction.*

Each of these sections is divided into paragraph specifications, designated both by title and by number and letter, as for example, under:

PART II—MATERIALS

3. AGGREGATES (*In general*).

3A. Samples.
3B. Sieve Analysis Requirements.
3C. Sieve Analysis Test.

4. FINE AGGREGATE.

4A. Quality.
Et cetera.

The matter enclosed in brackets, and immediately following the paragraph headings is for the purpose of identifying the particular use of the specifications, such as, for instance, on page 13 we have:

23B. Quality (*Joints in pavements*).
23C. Size (*Joints in pavements*).

Again on page 35 we have:

20F. Applying Hydrated Lime (*Portland cement stucco*).

It is obvious that these bracketed words are not necessary when specifications are being written for a particular class of construction.

At the beginning of Part II and Part III is an alphabetical index to all specification paragraphs in those sections. This index may be used to advantage as a helpful reminder to the Architect or Engineer in checking up on points to be covered when writing any specifications where uses of plain and reinforced concrete are to be treated.

Following the main body of specifications are Appendices containing: (1) Suggested Specifications for Strength Concrete; (2) Special Recommendations in reference to certain paragaphs in the main body of specifications; (3) a bibliography of specifications and tests of the A. I. A. (American Institute of

Architects) and the A. S. T. M. (American Society for Testing Materials); and (4) "Coded Specifications" for various constructional uses. The latter are made up of grouped paragraphs from the main body of specifications, being arranged in the order of using and, for brevity, are "coded" by paragraph number and letter only.

The Coded Specifications are preceded by an index, arranged alphabetically. This index leads to the grouped specifications above described under Appendix IV. The Index and the Coded Specifications have been arranged for the convenience of the busy architect or engineer who will find these "coded" groups of assistance in quickly assembling a set of specifications for a particular class of work. As a matter of caution, it should be borne in mind that the groups must be carefully rechecked before using.

How to Use the "Coded Specifications"

(1) Suppose, for example, the work to be covered pertains to the construction of a concrete bin for the storage of coal.

(2) Under "Index to Coded Specifications" find *Bins, Coal* and turn to the Specification number indicated, in which is given the assembled list of specification paragraphs by numbers and letters, arranged under *I—General, II—Materials, III—Construction.*

(3) The complete paragraphs may then be copied, in the order designated, from the main body of the Specifications.

(4) Paragraphs requiring material to be *inserted* by the architect or engineer will be indicated by the plus sign (+), and those requiring material to be *omitted*, by the asterisk (*) or otherwise, by note referring to the Appendix or giving the information direct.

(5) An asterisk (*) placed before a paragraph number means that all of the material in that particular paragraph must be omitted except that which pertains to the particular type of work being considered.

(6) A plus sign (+) placed before a paragraph number means that wording must be supplied by the architect or engineer either in whole or in part, pertaining to the particular type of work under consideration.

Concrete on "Strength" Basis

The practice of specifying concrete on a "strength" basis is both a desirable and a consistently increasing practice. Scientific research during recent years has brought the knowledge of the laws controlling the qualities of concrete to a point where it is both possible and feasible to forecast compressive strength in this material.

This being a fact, it is a logical development to abandon obsolete methods of specifying the use of empirical proportions and modernize our methods to comply with the latest developments.

Such a change of methods can come only by education of all concerned and a knowledge that the methods will produce results; consequently, careful study and consideration of these precepts is advised. Great economy and positive success have been the invariable results wherever these methods have been followed and it is recommended that they be given a trial.

On page 55 of the Appendix will be found suggested specifications to cover two methods of using these precepts, both of which are certain to bring about the same results, namely, "concrete of a known quality, predetermined as necessary to meet the demands put upon it by the design of the structure."

The first method follows present practice in that a definite proportion is specified, but this proportion is based upon a knowledge by the engineer or architect of the physical characteristics of the aggregates. This method also provides for changes to be made when necessary during the progress of the work, to insure that the desired strength shall be obtained in the finished concrete, without working a hardship upon either the owner or the contractor.

The second method departs from present practice in that it permits the contractor to deliver concrete of a certain specified compressive strength and leaves all details of materials, proportions and manipulation to his judgment. The acceptance or rejection of the finished product is dependent upon the results of certain tests as specified. Under such a contract the alert contractor will have an opportunity to effect considerable saving in cost to himself and also to the owner, through lower bids with the same margin of profit.

Index to

SPECIFICATIONS FOR PLAIN AND REINFORCED CONCRETE

PART II—MATERIALS

Items	Page	Paragraph
Aggregate, chatts, definition	10	8A
Aggregate, chatts, quality	10	8B
Aggregate, coarse, grading	9	5B
Aggregate, coarse, quality	9	5A
Aggregate, cinder, impurities	10	6B
Aggregate, cinder, quality	10	6A
Aggregate, cinder, size	10	6C
Aggregate, colored, quality	10	12A
Aggregate, cyclopean, quality	10	10B
Aggregate, fine, decantation test	9	4E
Aggregate, fine, grading of (concrete)	9	4F
Aggregate, fine, grading of (portland cement stucco)	9	4G
Aggregate, fine, impurities	9	4B
Aggregate, fine, mortar strength test for	9	4H
Aggregate, quality	9	4A
Aggregate, premixed	10	11
Aggregate, rubble, quality	10	9B
Aggregate, samples	8	3A
Aggregate, sieve analysis	8	3B
Aggregate, slag, impurities	10	7C
Aggregate, slag, grading	10	7D
Aggregate, slag, quality	10	7A
Aggregate, slag, weight	10	7B
Bar reinforcement	13	22F
Cast iron for reinforcement	13	22I
Chatts aggregates, definition	10	8A
Chatts aggregates, quality	10	8B
Cinder aggregate, impurities	10	6B
Cinder aggregate, quality	10	6A
Cinder aggregate, size	10	6C
Clay and silt	9	4D
Clay tile fillers	12	21F
Coarse aggregate, grading	9	5B
Coarse aggregate, quality	9	5A
Coatings, special protective, quality	14	25C
Colored aggregate, location	10	12B
Colored aggregate, quality	10	12A
Coloring pigment, location	11	15B
Coloring pigment, quality	11	15A
Colorimetric test for fine aggregates, A. S. T. M.	9	4B
Colorimetric test for fine aggregates, in field	9	4C
Concrete structural tile fillers	12	21D

Items	Page	Paragraph
Coarse aggregate, quality	9	5A
Cyclopean aggregate, definition	10	10A
Cyclopean aggregate, quality	10	10B
Damp-proofing, approval	14	24B
Damp-proofing, general statement	14	24A
Densifiers, approval	14	24B
Densifiers, general statement	14	24A
Densifiers, location	14	25C
Densifiers, quality	14	25C
Facings, special protective, approval	14	24B
Facings, special protective, general statement	14	24A
Filler, joint	13	23
Fine aggregate, decantation test for	9	4E
Fine aggregate, grading of (concrete)	9	4F
Fine aggregate, grading of (portland cement stucco)	9	4G
Fine aggregate, impurities	9	4B
Fine aggregate, mortar strength test for	9	4H
Fine aggregate, quality	9	4A
Forms, approval	11	17B
Forms, clay tile fillers	12	21F
Forms, concrete tile fillers	12	21D
Forms, gypsum tile fillers	12	21G
Forms, permanent, definition	12	21A
Forms, permanent, quality	12	21B
Forms, permanent, size and spacing	12	21C
Forms, steel tile fillers	12	21E
Forms, strength	11	17A
Forms, temporary combination definition	12	20A
Forms, temporary combination quality	12	20B
Forms, temporary combination size (one-course pavement)	12	20C
Forms, temporary lumber, definition	11	18A
Forms, temporary lumber, quality	11	18B
Forms, temporary lumber, size (pavements)	11	18C
Forms, temporary lumber, size (sidewalks)	11	18D
Forms, temporary steel, quality	11	19A
Forms, temporary steel, size (pavement without curb)	11	19B
Furring metal, size, back plastered construction	14	27B
General requirements of materials	8	1
Grading of coarse aggregate	9	5B
Grading of fine aggregate (concrete)	9	4F
Grading of fine aggregate (portland cement stucco)	9	4G
Grading of slag aggregate	10	7D
Gravel for coarse aggregate	9	5A
Gypsum tile fillers	12	21G
Hair or fibre (portland cement stucco)	11	16
Hardeners, approval	14	24B
Hardeners, general statement	14	24A
Hydrated lime, quality (portland cement stucco)	11	14A
Impurities of cinder aggregates	10	6B
Impurities of coarse aggregates	9	5A
Impurities of fine aggregates	9	4B
Impurities of slag aggregates	10	7C
Integral waterproofing	14	25A
Joint filler, quality	13	23A
Joint filler, quality (joints in pavements)	13	23B
Joint filler, size (joints in pavements)	13	23C
Joint filler, size	14	23D
Lath, metal, quality (portland cement stucco)	14	26A
Lath, metal, strength (portland cement stucco)	14	26B
Lime, hydrated, quality (portland cement stucco)	11	14A
Lumber for temporary forms (quality)	11	18B

Items	Page	Paragraph
Membrane waterproofing	14	25B
Mortar strength test	9	4H
Paint, location	14	25C
Paint, quality	14	25C
Portland cement, quality	8	2A
Portland cement, tests	8	2A
Premixed aggregates	10	11
Protective coatings, special, approval	14	24B
Protective coatings, special, general statement	14	24A
Protective coatings, special, location	14	25C
Protective coatings, special, quality	14	25C
Protective facings, special, approval	14	24B
Protective facings, special, general statement	14	24A
Protective facings, special, location	14	25C
Protective facings, special, quality	14	25C
Quality of cast iron used for reinforcement	13	22I
Quality of cinder aggregate	10	6A
Quality of chatts aggregates	10	8B
Quality of clay tile fillers	12	21F
Quality of coarse aggregate	9	5A
Quality of coloring pigments	11	15A
Quality of colored aggregate	10	12A
Quality of combination, forms	12	20B
Quality of concrete tile fillers	12	21D
Quality of cyclopean aggregate	10	10B
Quality of damp-proofing	14	25C
Quality of densifiers	14	25C
Quality of fine aggregate	9	4A
Quality of gypsum tile fillers	12	21G
Quality of hair or fibre	11	16A
Quality of hardener	14	25C
Quality of hydrated lime (portland cement stucco)	11	14A
Quality of joint filler	13	23A
Quality of lumber forms, temporary	11	18B
Quality of membrane waterproofing	14	25B
Quality of metal furring	14	27
Quality of metal lath	14	26A
Quality of paint	14	25C
Quality of portland cement	8	2A
Quality of rubble aggregate	10	9B
Quality of slag aggregate	10	7A
Quality of shoulder material (pavements)	14	28
Quality of sub-base material	15	29A
Quality of special protective coatings	14	25C
Quality of special protective facings	14	25C
Quality of steel bar reinforcement	13	22F
Quality of steel forms (temporary)	11	19A
Quality of steel tile fillers	12	21E
Quality of structural shapes for reinforcement	13	22H
Quality of superficial waterproofing	14	25C
Quality of water	11	13A
Quality of wire reinforcement	13	22G
Reinforcement, cast iron used for	13	22I
Reinforcement, cleanliness	12	22B
Reinforcement, location	13	22J
Reinforcement, minimum size	12	22C
Reinforcement, quality	13	22E
Reinforcement, wire	13	22G
Reinforcement, steel bar	13	22F
Reinforcement, structural steel shape used for	13	22H
Rubble aggregate, definition	10	9A

Items	Page	Paragraph
Rubble aggregate, quality	10	9B
Sand, quality	9	4A
Sample of aggregates	8	3A
Screenings, quality	9	4A
Sedimentation test	9	4E
Sieve analysis requirements for aggregates	8	3B
Sieve analysis test for aggregates	8	3C
Silt and clay	9	4D
Shoulder material, location (pavements)	14	28
Slag aggregate, impurities	10	7C
Slag aggregate, quality	10	7A
Slag aggregate, grading	10	7D
Steel bar reinforcement	13	22F
Steel tile fillers	12	21E
Structural steel reinforcement	13	22H
Structural tile fillers, concrete	12	21D
Sub-base material, location (slabs)	15	29B
Sub-base material, quality (slabs)	15	29A
Superficial waterproofing	14	25C
Tests, colorimetric for fine aggregates, A. S. T. M.	9	4B
Tests, colorimetric for fine aggregates, field	9	4C
Tests, sedimentation	9	4E
Tests, mortar strength for fine aggregates	9	4H
Tests, sieve analysis for aggregates	8	3C
Tile, clay filler	12	21F
Tile fillers, structural concrete	12	21F
Tile gypsum filler	12	21G
Tile steel filler	12	21E
Water, quality	11	13A
Waterproofing, approval	14	24B
Waterproofing, general statement	14	24A
Waterproofing, integral	14	25A
Waterproofing, membrane	14	25B
Waterproofing, superficial	14	25C
Wire reinforcement	13	22G

SPECIFICATIONS

FOR

PLAIN AND REINFORCED CONCRETE

PART I—GENERAL

1. GENERAL CONDITIONS.

The plain and reinforced concrete work shall be governed by the "General Conditions of the Contract," these specifications, and the plans.

(*Note to Architect or Engineer:* Consult Standard Documents of A. I. A. for standard General Conditions of the Contract.

2. SCOPE OF WORK.

The plain and reinforced concrete work is summarized as follows:

(*Note to Architect and Engineer:* It is assumed that under this heading the architect or engineer will insert all general clauses and specials pertaining to and describing in full the particular job and class of work under consideration.)

PART II—MATERIALS

1. GENERAL REQUIREMENTS.

Unless otherwise specified the quality of materials to be used shall be as specified in this section.

2. PORTLAND CEMENT.

2A. Quality.

Portland cement shall meet the requirements of the current "Standard Specifications and Tests for Portland Cement" adopted by the American Society for Testing Materials. (Serial No. C 9-21.)

3. AGGREGATES (*In General*).

3A. Samples.

Before delivery on the job, the contractor shall submit to the architect or engineer a 50-pound sample of fine and a 100-pound sample of coarse aggregate proposed for use. These samples shall be tested as hereinafter specified and if found to pass the requirements of the specifications, similar material shall be considered as acceptable for the work.

3B. Sieve Analysis Requirements.

The sieves and method of making sieve analysis, hereinafter required for grading aggregates, shall conform to the current "Method of Test for Sieve Analysis of Aggregates for Concrete" of the American Society for Testing Materials (Serial No. C 41-21T) or to the Sieve Analysis Test as hereinafter specified.

3C. Sieve Analysis Test.

A sieve analysis, to determine the Fineness Modulus, shall be made of both the fine and coarse aggregates. A set of U. S. Standard Square Mesh Sieves shall be used, each sieve having a clear opening double the width of the next smaller size. These sizes are 100, 48, 28, 14, 8 and 4 meshes per linear inch, and $\frac{3}{8}$-inch, $\frac{3}{4}$-inch and $1\frac{1}{2}$-inch. For larger aggregates 3-inch and 6-inch sieves shall also be used.

The percentage of the aggregates, either by weight or by volume, coarser than each sieve, shall be measured. The sum of these percentages, divided by 100, is called the Fineness Modulus of that aggregate.

4. FINE AGGREGATE.

4A. Quality.

Fine aggregate shall consist of sand, stone screenings or other inert materials with similar characteristics or a combination thereof, having hard, strong, durable grains, and shall be free from injurious amounts of dust, lumps, soft or flaky particles, and shale.

4B. Impurities.

Fine aggregate shall be free from alkali and surface coatings, and shall not contain injurious amounts of vegetable or other organic matter as determined by the Colorimetric Test described in the "Tentative Method of Test for Organic Impurities" of the American Society for Testing Materials (Serial No. C 40-21 T), or by the Field Colorimetric Test as hereinafter specified.

4C. Colorimetric Test.

The Colorimetric Test shall be applied in the field as follows: Fill a 12-ounce graduated prescription bottle to the 4½-ounce mark with the fine aggregate to be tested. Add a 3 per cent solution of sodium hydroxide (caustic soda) until the volume of fine aggregate and solution, after shaking, amounts to 7 ounces. Shake thoroughly and let stand for 24 hours. The sample should then show a practically colorless solution not darker than straw color. If the solution on top is darker than straw color, the fine aggregate represented by the sample shall be rejected unless it has satisfactorily passed the mortar strength test as hereinafter specified.

4D. Silt and Clay.

Fine aggregate shall not contain injurious amounts of silt and clay as determined by the "Standard Method of Test for Quantity of Clay and Silt in Sand for Highway Construction" (Serial No. D 74-21) of the American Society for Testing Materials, or by the sedimentation test as hereinafter specified.

4E. Sedimentation Test. (A. S. T. M. Tentative Standard D-136-22T.)

The sedimentation test to determine the presence of silt and clay shall be as follows: Fill a 32-ounce graduated prescription bottle to the 14-ounce mark with the fine aggregate to be tested; add water to the 28-ounce mark; shake vigorously for 1 minute; allow to settle for 1 hour. If more than 1 ounce of sediment appears above the fine aggregate, the material represented by the sample shall be rejected.

4F. Grading (*Fine aggregate*).

Fine aggregate shall range in size from fine to coarse, preferably within the following limits:

Passing through No. 4 Sieve.....not less than 85 per cent
Passing through No. 50 Sieve.....not more than 30 per cent

4G. Grading (*Portland cement stucco*).

Fine aggregate shall be graded from fine to coarse and when dry shall pass a screen having 8 meshes per linear inch.

4H. Mortar Strength Test.

Fine aggregate shall be of such quality that mortar composed of 1 part of portland cement and 3 parts of fine aggregate, by weight, when made into briquets, shall show a tensile strength at 7 and 28 days at least equal to the strength of briquets composed of 1 part of the same cement and 3 parts of standard Ottawa sand, by weight. The percentage of water used in making the briquets of cement and fine aggregate shall be such as to produce a mortar of the same consistency as that of the Ottawa sand briquets of Standard consistency. In other respects briquets shall be made in accordance with the methods of testing cement recommended by the American Society for Testing Materials. (Serial No. C 9-21.)

5. COARSE AGGREGATE.

5A. Quality.

Coarse aggregate shall consist of crushed stone, gravel, air cooled blast furnace slag, or other approved inert materials with similar characteristics, or combinations thereof, having hard, strong, durable particles free from injurious amounts of soft, friable, thin, elongated or laminated pieces, alkali, organic or other harmful matter.

5B. Grading (*Coarse aggregate*).

Coarse aggregate shall range in size from fine to coarse within the following limits:

Passing ..... in. Sieve (maximum size).....not less than 95 per cent
Passing ..... in. Sieve (intermediate size)..... ..... to .....per cent
Passing No. 4 Sieve.....not more than 15 per cent
Passing No. 8 Sieve.....not more than 5 per cent

(*Note:* The Architect or Engineer should insert in the blanks the sizes of aggregates required. See Appendix II for "Table of Desirable Gradings.")

6. CINDER AGGREGATE.

6A. Quality.

Cinders shall be of best quality, resulting from thoroughly burning coal at high temperatures in industrial furnaces. The use of gas-house or locomotive cinders is prohibited.

6B. Impurities.

Cinders shall be washed. They shall be free from injurious amounts of ash, unburned coal, coke vegetable, and other harmful materials.

6C. Size.

Cinders shall pass a 1-inch square mesh. All dust shall be screened out.

7. SLAG AGGREGATE.

7A. Quality.

The broken slag shall consist of roughly cubical fragments of air-cooled blast furnace slag. It shall be reasonably uniform in density and quality.

7B. Weight of Slag.

The weight of slag when shaken to refusal shall be at least 70 pounds per cubic foot.

7C. Impurities.

The slag shall be reasonably free from metallic iron and contain no dirt or other objectionable matter.

7D. Grading.

Slag shall be graded the same as specified for grading of coarse aggregate.

8. CHATTS AGGREGATES.

8A. Definition.

Chatts is a term locally applied to a by-product or waste product of certain mining operations.

8B. Quality.

Chatts must conform to the specifications for fine and coarse aggregates.

9. RUBBLE AGGREGATE.

9A. Definition.

Rubble aggregate is stone larger than coarse aggregate and not larger than one-man stone (stone weighing not more than 100 pounds).

9B. Quality.

Rubble aggregate shall consist of clean, hard, strong and durable stone.

10. CYCLOPEAN AGGREGATE.

10A. Definition.

Cyclopean aggregate is stone larger than one-man stone.

10B. Quality.

Cyclopean aggregate shall consist of clean, hard, strong, and durable stone; free from fissures and planes of cleavage.

11. Premixed Aggregate.

Crusher-run stone, bank run gravel and artificially prepared mixtures of fine and coarse aggregates shall not be used unless same are tested beforehand and proportioned so as to insure obtaining a concrete of the required quality, density and strength.

12. COLORED AGGREGATE.

12A. Quality.

Aggregate used for coloring shall be equal in color, quality, and grading to....., as manufactured by .....

12B. Location.

(To be supplied by Architect or Engineer.)

13. WATER.

13A. Quality.

Water shall be clear and free from oil, acid, alkali, organic matter or other deleterious substances. It shall preferably be equal in all physical and chemical properties to potable water.

14. HYDRATED LIME (*Portland Cement Stucco*).

14A. Quality.

Hydrated lime shall meet the requirements of the current Standard Specifications of the American Society for Testing Materials for Hydrated Lime. (Serial No. C 6-15.)

15. COLORING PIGMENTS.

15A. Quality.

Only mineral pigments shall be used. These pigments must be fully guaranteed by their manufacturer to be permanent and unaffected by lime, cement, and weather.

15B. Location.

(To be supplied by Architect or Engineer.)

16. HAIR OR FIBRE (*Portland Cement Stucco*).

16A. Quality.

Only first quality long hair, or a long fibre well combed out, free from foreign matter, shall be used.

17. FORMS IN GENERAL.

17A. Strength.

Forms shall be of sufficient strength and rigidity so that, when properly supported, they will not deflect under the weight or pressure of the wet concrete and other loads incident to construction.

(*Note to Architect or Engineer:* It may be advisable to insert here the thickness of lumber and spacing of studding for various parts of the work.)

17B. Approval.

Forms shall be of a type approved by the Architect or Engineer.

18. TEMPORARY LUMBER FORMS.

18A. Definition.

Temporary lumber forms are forms not left permanently in place.

18B. Quality.

Lumber used in form shall be free from warp. For exposed surfaces it shall be dressed to a uniform width and thickness and be free from loose knots. For unexposed surfaces and rough work, undressed lumber may be used.

18C. Size (Pavements).

Lumber used in forms shall be of at least 3-inch stock (dressed dimension).

18D. Size (Sidewalks).

Lumber used in forms shall be of at least 2-inch stock (dressed dimension).

19. TEMPORARY STEEL FORMS.

19A. Quality.

(Use manufacturers' specifications.)

19B. Size (*Pavement without curb*).

Metal forms shall have a flat surface on top, at east 1¾ inches wide.

Metal forms for tangents and curves having radii of 150 feet and over shall be of shaped steel sections at least 10 feet in length, and for curves of less radii, they shall be at least 5 feet in length. Steel plate in forms shall have a thickness of at least No. 10 gauge. Metal forms shall have a depth equal to the side thickness of pavement.

20. TEMPORARY "COMBINATION FORMS".

20A. Definition.

Temporary "combination forms" are forms made of more than one material. These forms are not left permanently in place.

20B. Quality.

(Quality to be supplied by Architect or Engineer).

20C. Size (*One Course Pavement*).

Wood forms shall be capped along the upper inside edge with 2-inch angle iron. These forms shall have a depth equal to the thickness of the pavement.

21. PERMANENT FORMS.

21A. Definition.

All forms such as those used for joist and slab floor construction and permanently left in place shall be known as permanent forms.

21B. Quality.

(Quality is to be supplied from manufacturers' specifications.)

21C. Size and Spacing.

The size and spacing of permanent forms shall be as indicated on the plans.

21D. Concrete Structural Tile Fillers.

Concrete tile fillers shall in all respects meet the requirements for medium load bearing tile as provided for in the "Proposed Standard Specifications for Concrete Building Block and Concrete Building Tile" of the American Concrete Institute.

21E. Steel Tile Fillers.

The steel tile fillers shall be.....(*according to manufacturers' specifications*).

21F. Clay Tile Fillers.

Clay tile fillers shall be.....(*according to manufacturers' specifications*).

21G. Gypsum Tile Fillers.

Gypsum tile fillers shall be.....(*according to manufacturers' specifications*).

22. REINFORCEMENT.

22A. General Requirements.

Metal reinforcement shall be of a quality and character meeting the requirements of the Standard Specifications for Billet Steel Concrete Reinforcement Bars, (Serial Designation: A 15-14) of the American Society for Testing Materials.

22B. Cleanliness.

Metal reinforcement shall be clean, free from injurious amounts of rust, paint, oil, and other materials that might reduce its bond strength with the concrete.

22C. Minimum Size.

The weights or cross-sectional areas at all points shall be at least equal to the weights or areas corresponding to the sizes indicated on the plans, or in these specifications.

22D. Reinforcement (*Pavement*).

Reinforcement shall consist of steel fabric, or of steel bars, or a combination of both and shall have an effective weight exclusive of dowel bars at joints and of circumferential bars of at least ..... pounds per 100 square feet.

(a) *Steel Fabric.* Steel fabric shall be manufactured from cold drawn wire and shall comply with tentative standards of the American Society for Testing Materials, (Serial Designation A 82-21T.)

The spacing of primary members shall be not more than ..... inches, and of secondary members not more than ..... inches.

(b) *Steel Bar Reinforcement.* This style of reinforcement shall consist of steel bars of the size, shape and spacing shown on the plans, and shall be properly formed into mats. All intersections of longitudinal and transverse bars along the exterior edges of the mat and every other

intersection of the longitudinal and transverse bars in the interior of the mat shall be securely wired or clipped together to resist displacement during handling and concreting operations. The materials shall have an effective weight of not less than ..... pounds per 100 square feet, exclusive of laps, ties, clamps, chairs, and such portions of the bars as are not in the plane of the mat for their full lengths.

Steel bars shall comply with the standard requirements for Concrete Reinforcement Bars of the American Society for Testing Materials, (Serial designation A 15-14). . All bar reinforcement, when placed in the pavement shall be free from excess rust, scale or other substance which prevents the bonding of the concrete to the reinforcement. When in storage on the work, bars shall be protected from corrosion by placing them on a dry platform under a weatherproof cover.

22E. Quality.

The quality of reinforcement shall be as specified below.

22F. Steel Bars.

The quality of the various grades of steel-bar reinforcement listed below shall correspond to the requirements of the current "Standard Specifications for Steel-Concrete Reinforcement" of the American Society for Testing Materials. Structural Steel Grade shall be used unless otherwise specified.

(a) Billet Steel, Plain Bars, Structural Steel Grade (Serial No. A15-14).
(b) Billet Steel, Plain Bars, Intermediate Grade (Serial No. A15-14).
(c) Billet Steel, Plain Bars, Hard Grade (Serial No. A15-14).
(d) Billet Steel, Deformed Bars, Structural Steel Grade (Serial No. A15-14).
(e) Billet Steel, Deformed Bars, Intermediate Grade (Serial No. A15-14).
(f) Billet Steel, Deformed Bars, Hard Grade (Serial No. A15-14).
(g) Billet Steel, Cold Twisted Bars (Serial No. A15-14).
(h) Rail Steel, Plain Bars (Serial No. A16-14).
(i) Rail Steel, Deformed Bars (Serial No. A16-14).
(j) Rail Steel, Hot Twisted Bars (Serial No. A16-14).

22G. Wire.

Wire for concrete reinforcement shall conform to the requirements of the tentative "Specifications for Cold-drawn Steel Wire for Concrete Reinforcement" of the American Society for Testing Materials. (Serial No. A 82-21 T.)

22H. Structural Steel.

Structural steel shapes used for reinforcement shall conform to the requirements of the Standard Specifications for Structural Steel for Bridges (Serial No. A 7-21) of the American Society for Testing Materials or of the Standard Specifications for Structural Steel for Buildings (Serial No. A 9-21) of the American Society for Testing Materials.

(*Note:* The Architect or Engineer should strike out one of these titles.)

22I. Cast Iron.

Cast iron used for reinforcement in composite columns shall conform to the requirements of the current "Standard Specifications for Cast Iron Pipe and Special Castings" of the American Society for Testing Materials. (Serial No. A 44-04.)

22J. Location.

The location of the above grades of reinforcement shall be as follows:

(To be supplied by Architect or Engineer.)

23. JOINT FILLER.

23A. Quality.

Joint filler shall be a suitable material that will not become soft and run in hot weather or become brittle in cold weather.

23B. Quality (*Joints in pavements*).

Joint filler shall consist of prepared strips of fibre matrix and bitumen, containing less than 25 per cent of inert material.

23C. Size (*Joints in pavements*).

The joint filler shall have a thickness of not less than ¼ inch or more than ¾ inch. The prepared strips shall be cut to conform to the cross-section of the pavement and shall be at least ½ inch wider

than the thickness of the pavement at any point. The length of filler shall be equal to the width of pavement, except that strips equal in length to half the width of pavement may be used when they are effectively laced or clipped together at the center.

23D. Size, Longitudinal Concealed Metal Joint (*Pavement*).

The metal used in this joint shall be not less than 18-gauge and may be either painted or galvanized.

The metal used may be of any length provided it is staked in place as hereinafter specified.

The pins used shall be of mild steel ⅜ inch in diameter and not less than 15 inches in length.

24. DAMPPROOFING, PROTECTIVE COATINGS, PROTECTIVE FACINGS, HARDENERS, AND DENSIFIERS.

24A. General Statement.

These materials are not required if concrete is manufactured with proper attention to all details and principles in these specifications, regarding the choice of materials, proportions, consistency, mixing, placing, curing, and protection.

24B. Approval.

When these materials are used they must be approved by the Architect or Engineer.

25. WATERPROOFING.

25A. Integral.

Integral waterproofing materials shall not be used in concrete.

25B. Membrane.

The kinds of membranous waterproofing and the places for using them shall be as follows:

(To be supplied by the Architect or Engineer.)

25C. Superficial.

The kinds of superficial waterproofing and places of using them shall be as follows:

(To be supplied by Architect or Engineer.)

26. LATH (*Portland Cement Stucco*).

26A. Quality.

Lath shall be of expanded metal, galvanized or painted.

26B. Strength.

The lath for stucco shall be at least equal in strength and rigidity to expanded metal lath weighing not less than 3.4 pounds per square yard and supported at intervals of 12 inches.

26C. Wire Lath.

Wire lath shall be galvanized or painted woven wire lath, not lighter than 19-gauge, 2½ meshes to the inch with stiffeners at 8-inch centers.

27. FURRING (*Portland Cement Stucco*).

27A. General.

When furring forms an integral part of the metal lath to be used, separate furring is to be omitted.

27B. Backplastered Construction.

In backplastered construction ⅜-inch crimped furring, not lighter than 22-gauge, or other shape giving equal results, shall be used.

27C. Sheathed Construction

In sheathed construction ⅜-inch crimped furring not lighter than 22-gauge, or other shape giving equal results, shall be used.

27D. Wood Furring.

Wood furring strips shall be of sound, clear white pine, 1x2-inch dimension.

28. SHOULDER MATERIAL (*Pavement*).

(*Note:* Any special materials for the construction of shoulders should here be described as desired by the Engineer.)

29. SUB-BASE MATERIAL (*Slabs*).

29A. Quality.

(*Note:* Cinders, sand or gravel may be used with satisfactory results as a sub-base for concrete slabs.)

29B. Location.

(Location to be designated by Architect or Engineer.)

Index to

SPECIFICATIONS FOR PLAIN AND REINFORCED CONCRETE

PART III—CONSTRUCTION

Items	Page	Paragraph
Admixture and integral compounds—see Integral compounds and admixtures.		
Absorption test (products)	54	55G
Absorption test requirements (concrete block and tile)	54	55H
Absorption test requirements (concrete brick)	54	55I
Acid proofing (storage structures)	49	50A
Aggregates, change of fine and coarse	34	19J
Aggregates, measuring	34	19C
Aggregates, storage, elevated bins	28	6E
Aggregates, storage, general requirements	28	6D
Anchors in concrete	33	17
Antifreezing materials	46	43D
Architectural concrete trimstone and facing stone—see Concrete trimstone and facing stone.		
Attachments to concrete	33	17
Backfill, application (arches)	27	5C
Backfill, compacting	27	5D
Backfill, shoulders (pavements)	27	5E
Backfill, time of placing (other than structures resisting fluid pressure)	27	5A
Backfill, time of placing (structures resisting fluid pressure)	27	5B
Backplastering on metal lath (portland cement stucco)	43	36G
Barricades (pavements)	46	44A
Base, quality, masonry in general (to receive portland cement stucco)	41	34A
Base, monolithic concrete, quality (to receive portland cement stucco)	41	34B
Base, quality, concrete block and tile (to receive portland cement stucco)	41	34C
Base, quality, clay brick (to receive portland cement stucco)	42	34E
Base, quality, clay tile (to receive portland cement stucco)	41	34D
Base, quality, framework (to receive portland cement stucco)	42	34F
Base, quality, wood sheathing (to receive portland cement stucco)	42	34G
Belting (pavement)	40	33C
Bond ties	33	17
Bonding concrete, general	38	27C
Bonding concrete, construction joints—see Joints, construction.		
Bonding concrete, for watertight joints	31	12A
Bonding concrete, with finishes	39	30D
Bonding concrete, future steel reinforcement	33	14L
Bracing or centering—see Centering or bracing.		
Bucket, drop bottom	38	28D
Building block and building tile	52	54
Building block and building tile (fire stops)	53	54F
Building block and building tile, general requirements	52	54A
Building block and building tile, jointing (types of)	53	54D
Building block and building tile, jointing (basements)	53	54E
Building block and building tile, laying blocks	53	54C

Items	Page	Paragraph
Building block and building tile mortar (laying blocks)	52	54B
Cement, increase of ratio	34	19I
Cement, measuring	34	19D
Centering or bracing, strength	28	7F
Centering or bracing, approval (designed by contractor)	29	7G
Centering or bracing, removal	29	7H
Clay tile fillers	29	9E
Cleaning concrete after protection and curing, general requirements	48	46A
Cleaning, concrete transporting equipment	36	25A
Cleaning, concrete for bonding	38	27C
Cleaning, concrete for finishing	39	30A
Cleaning, concrete construction joints	31	13A
Cleaning, concrete mixer	35	21A
Cleaning, concrete trimstone and facing stone	45	39I
Cleaning, forms	28	7B
Cleaning, reinforcement	32	14A
Cofferdams	26	2D
Cold weather protection—see Protection, cold weather.		
Collars in concrete	33	17
Colored aggregate facing	43	37A
Colored mortar facing	43	37B
Coloring pigment, application (mortar)	35	20E
Coloring pigment, quantity of (concrete or mortar not subject to wear)	35	20D
Concrete building block and tile—see Building block and tile.		
Concrete covering over steel—see Covering, over steel.		
Concrete, damp-proofing for	49	49
Concrete drain tile—see Drain tile, laying		
Concrete facing, colored aggregate	43	37A
Concrete facing, colored mortar	43	37B
Concrete facing, application	43	37C
Concrete, forms—see Forms.		
Concrete, general types	33	18A
Concrete roofing tile, placing of—see Roofing tile, placing		
Concrete sewer pipe—see Sewer pipe, laying		
Concrete trimstone and facing stone, placing	44	39
Concrete trimstone and facing stone, cleaning	45	39I
Concrete trimstone and facing stone, defective work	45	39H
Concrete trimstone and facing stone, delivery and storage	45	39B
Concrete trimstone and facing stone, general requirements	44	39A
Concrete trimstone and facing stone mortar	45	39C
Concrete trimstone and facing stone pointing	45	39F
Concrete trimstone and facing stone protection after setting	45	39G
Concrete trimstone and facing stone setting	45	39D
Concrete trimstone and facing stone setting (in monolithic concrete construction)	45	39E
Compacting and wetting sub-grade and sub-base	27	4F
Compacting backfill	27	5D
Compacting concrete	38	27B
Compression test	36	24
Compression test, final (products)	53	55D
Compression test requirements (concrete block and tile)	54	55E
Compression test requirements (concrete brick)	54	55F
Construction, general requirements	26	1
Construction joints—see Joints, construction.		
Consistency, A. S. T. M	34	19E
Consistency, flow table test	34	19G
Consistency, slump test	34	19F
Continuous placing of concrete	36	26C
Contraction and expansion joints—see Joints, expansion.		
Covering, concrete, over steel, concrete exposed to air	33	15A
Covering, concrete, over steel, concrete exposed to alkali soils or water	33	15E
Covering, concrete, over steel, concrete exposed to sea water	33	15F

Items	Page	Paragraph
Covering, concrete, over steel, fire protection (first-class aggregate)	33	15B
Covering, concrete, over steel, fire protection (second-class aggregate)	33	15C
Covering, concrete, over steel, ordinary fire protection	33	15D
Covering, concrete, over steel, pavements	33	15G
Covering, concrete, over cyclopean aggregate	38	26O
Covering, concrete, over rubble aggregate	37	26N
Cracks, pointing (concrete)	39	31A
Crossings (pavements)	47	44B
Curing and protection in general	46	41
Curing, disposal of water after (pavements)	48	45N
Curing, general requirements	47	45A
Curing, method (concrete tank)	48	45M
Curing, operating spray chamber (products)	47	45D
Curing, operating steam chamber (products)	47	45C
Curing, ponding	47	45F
Curing, sprinkling	47	45E
Curing, temperature of curing chamber (products)	47	45B
Curing, time after removal from chamber (products)	47	45I
Curing, time in spray chamber (products)	47	45H
Curing, time in steam chamber (products)	47	45G
Curing, time (floor, stair and similar wear surfaces)	48	45J
Curing, time (pavements and sidewalk surfaces)	48	45K
Curing, time (surfaces not subject to wear)	48	45L
Cyclopean aggregate	38	26O
Damp-proofing, general	48	47A
Damp-proofing to be used	49	49
Decorative finishes, general requirements	43	38A
Decorative finishes, joints	41	33I
Decorative finishes, pebbled ash	44	38I
Decorative finishes, rough cast or spatter dash	44	38J
Decorative finishes, rub	43	38C
Decorative finishes, sand blast	44	38E
Decorative finishes, sand floated	44	38G
Decorative finishes, sand sprayed	44	38L
Decorative finishes, scrubbed	44	38D
Decorative finishes, smooth	43	38B
Decorative finishes, sponge	44	38K
Decorative finishes, stippled	44	38H
Decorative finishes, tooled	44	38F
Defective work (concrete trimstone and facing stone)	45	39H
Delivery and storage (concrete trimstone and facing stone)	45	39B
Depth, driving concrete piles	39	29D
Division plates, plain joints	30	11C
Drainage, relieving water pressure (vent pipes)	26	3B
Drainage, removal of water (excavations)	26	3A
Drainage, tile drain (heavy soils having poor natural drainage)	26	3C
Drains (curb and gutter)	26	3D
Drain tile—see Drainage and Drain tile, laying of.		
Drain tile, laying of	50	51
Drain tile, laying of, blinding and backfilling	50	51E
Drain tile, laying of, excavation of trench	50	51B
Drain tile, laying of, general requirements	50	51A
Drain tile, laying of, inspection, visual (at the trench)	50	51C
Drain tile, laying of (laying the tile)	50	51D
Driving, concrete piles—see Piles.		
Elevated bins, storage of dry concrete materials	28	6F
Excavation, cofferdams	26	2D
Excavation, dimensions	26	2A
Excavation, depth (foundations)	26	2E
Excavation, sheet piling and shoring	26	2C
Excavation, soil bearing test	26	2B

Items	Page	Paragraph
Expansion and contraction joints—see Joints, expansion and contraction.		
Facing for concrete—see Concrete, facing.		
Facing stone, concrete—see Concrete trimstone and facing stone.		
Falsework or centering, approval (designed by contractor)	29	7G
Fillers, structural concrete tile	29	9B
Fillers, clay tile	29	9E
Fillers, gypsum	29	9D
Fillers, steel	29	9C
Final tests—see Tests, final.		
Finished surfaces, trueness of (pavements)	46	40A
Finishes, decorative—see Decorative finishes.		
Finishing, wear surfaces, adjacent to integral curb	41	33H
Finishing, wear surfaces, belting (pavements)	40	33C
Finishing, wear surfaces, floating	40	33E
Finishing, wear surfaces, joints and edges (pavements)	41	33F
Finishing, wear surfaces, joints and edges (sidewalks)	41	33G
Finishing, wear surfaces, longitudinal floating (pavements)	40	33E
Finishing, wear surfaces, machining (pavements)	40	33D
Fire-protective covering, (first-class aggregate)	33	15B
Fire-protecting covering, (second-class aggregate)	33	15C
Fire-protective covering, ordinary	33	15D
Fixtures in concrete	33	17
Floating, longitudinal (pavements)	40	33E
Floating (wear surfaces)	40	33E
Floor tile fillers—see Fillers.		
Fluidtight joints—see Joints, fluidtight.		
Forms in general, approval of false work or centering (designed by contractor)	29	7G
Forms in general, cleaning	28	7B
Forms in general, general requirements	28	7A
Forms in general, inspection	28	7E
Forms in general, removal of centering and shores	29	7H
Forms in general, strength of centering	28	7F
Forms, permanent, general requirements (floors)	29	9A
Forms, permanent, concrete tile fillers	29	9B
Forms, permanent, steel tile fillers	29	9C
Forms, permanent, hollow clay tile fillers	29	9E
Forms, permanent, gypsum tile fillers	29	9D
Forms, temporary, height (pavement with curb)	29	8E
Forms, temporary, height (pavement without curb)	29	8D
Forms, temporary removal general requirements	29	8G
Forms, temporary, sliding forms	29	8F
Forms, temporary, supports for wood forms (pavements)	29	8B
Forms, temporary, supports for metal forms (pavements)	29	8C
Forms, temporary, tying, general requirements	29	8A
Forms, treatment of, (block, brick, etc.)	28	7D
Furring and lathing, fastening to masonry surfaces (portland cement stucco)	42	35B
Furring and lathing, fastening to wood sheathing (portland cement stucco)	42	35C
Furring and lathing, metal lath	42	35D
General requirements of construction	26	1
General requirements of concrete trimstone and facing stone (placing of)	44	39A
General requirements, driving piles	39	29A
Gypsum tile fillers	29	9D
Hand mixing	35	22
Heating concrete materials and concrete—see Protection from cold.		
Heat, protection from—see Protection, heat.		
Horizontal construction joints	32	13H
Horizontal fluidtight joints	31	12A
Hydrated lime, applying (portland cement stucco)	35	20F
Hydrated lime, quantity of (portland cement stucco)	35	20B
Increase of cement ratio	34	19I
Inserts in concrete	33	17

Items	Page	Paragraph
Inspection (forms in general)	28	7E
Integral compounds and admixtures, applying hydrated lime (portland cement stucco)	35	20F
Integral compounds and admixtures, applying pigment (mortar)	35	20E
Integral compounds and admixtures, combined quantity (portland cement stucco)	35	20B
Integral compounds and admixtures, general statement	35	20A
Integral compounds and admixtures, intensity of color	35	20C
Integral compounds and admixtures, quantity hydrated lime (portland cement stucco)	35	20B
Integral compounds and admixtures, quantity pigment	35	20D
Integral waterproofing	49	48G
Joint filler trimming (pavements)	30	10H
Joint finish—see Joints and edges.		
Joints and edges, finishing (pavements)	41	33F
Joints and edges, finishing (sidewalks)	41	33G
Joints, construction, columns	31	13B
Joints, construction, crosswise of buildings	31	13D
Joints, construction, general requirements	31	13A
Joints, construction, horizontal	32	13H
Joints, construction, longitudinal (pavements)	31	13F
Joints, construction, concealed metal (pavements)	32	13G
Joints, construction, (reinforced concrete floor, slabs, beams and girders)	31	13C
Joints, construction, transverse (pavement)	31	13E
Joints, expansion and contraction, alignment (pavement integral curb)	30	10D
Joints, expansion and contraction, between pavement and rigid structures	30	10C
Joints, expansion and contraction, crosswise structures	30	10J
Joints, expansion and contraction, forming (sidewalks)	30	10E
Joints, expansion and contraction, general requirements	30	10A
Joints, expansion and contraction, location (sidewalks)	30	10B
Joints, expansion and contraction, longitudinal (pavements)	30	10G
Joints, expansion and contraction, seats of sliding joints	30	10I
Joints, expansion and contraction, transverse (pavements)	30	10F
Joints, expansion and contraction, trimming joint filler	30	10H
Joints, fluidtight (horizontal)	31	12A
Joints, fluidtight (vertical)	31	12B
Joints, plain, between floor slab and wall	30	11B
Joints, plain, between pavement and separate curb	31	11D
Joints, plain, division plates	30	11C
Joints, plain, forming (plain concrete slabs)	30	11A
Joints, pointing of (old stone masonry)	39	31B
Lap of bars (pavements)	32	14I
Lap of fabric	32	14J
Lath, metal (portland cement stucco)	42	35D
Lathing and furring—see Furring and lathing.		
Longitudinal construction joints (pavements)	32	13G
Longitudinal expansion joints (pavements)	30	10G
Machine finish (pavements)	40	33D
Machine mixing—see Mixing.		
Materials, storage of, general requirements	28	6A
Measuring—see Proportioning.		
Membrane waterproofing	48	48
Membrane waterproofing, application of	49	48E
Membrane waterproofing, application of mastic	49	48D
Membrane waterproofing, application of priming coat	49	48C
Membrane waterproofing, general requirements	48	48A
Membrane waterproofing, preparation of surface	48	48B
Membrane waterproofing, membrane protection	49	48F
Metal forms (pavements), supports for	29	8C
Method of placing, concrete piles (precast)	39	29B
Mixer, concrete, capacity of	35	21B
Mixer, concrete, speed of	35	21E
Mixer, concrete, type of	35	21E
Mixing, amount of concrete to mix	35	21C

Items	Page	Paragraph
Mixing, amount of mortar to mix (portland cement stucco)	35	21D
Mixing, capacity of mixing plant	35	21B
Mixing, general requirements	35	21A
Mixing, hand	35	22
Mixing, machine	35	21G
Mixing, time of machine mixing concrete	35	21H
Mixing, time of machine mixing mortar (portland cement stucco)	35	21H
Mixing, type of machine mixer	35	21E
Mortar facing, application	43	37C
Mortar concrete trimstone and facing stone (placing of)	45	39C
Nailing blocks in concrete	33	17
Notification of other contractors	33	16
Offsets in compression reinforcement	32	14K
Oiltight joints—see Joints, fluidtight.		
Oilproofing (oil storage structures)	49	50A
Pebble dash finish	44	38I
Pigment, coloring—see Coloring pigment.		
Piles, precast (driving of)	39	29
Piles, precast, depth to be driven	39	29D
Piles, precast, general requirements	39	29A
Piles, precast, method of placing	39	29B
Piles, precast, protection of piles	39	29C
Piles, precast, rate of penetration	39	29E
Placing backfill, time of (other than structures resisting fluid pressure)	27	5A
Placing backfill, time of (structures resisting fluid pressure)	27	5B
Placing backfill, application, arches	27	5C
Placing backfill, compacting	27	5D
Placing backfill, shoulders, pavements	27	5E
Placing concrete in air, bonding	38	27C
Placing concrete in air, compacting	38	27B
Placing concrete in air, general requirements	38	27A
Placing concrete, approval	36	26A
Placing concrete, continuously	36	26C
Placing concrete, cyclopean aggregate	38	26O
Placing concrete, integral curb	37	26L
Placing concrete, general requirements	36	26B
Placing concrete, method (arches)	37	26E
Placing concrete, method (one-course pavement with reinforcement)	37	26I
Placing concrete, method (one-course slabs)	37	26G
Placing concrete, method (two-course pavement with reinforcement)	37	26J
Placing concrete, method (two-course slabs)	37	26H
Placing concrete, order (fluidtight structures)	36	26D
Placing concrete, order (pavements)	37	26F
Placing concrete, rubble aggregate	37	26N
Placing concrete, screeding (pavement)	37	26K
Placing concrete, thin wall sections	37	26M
Placing precast concrete units, general requirements—see Concrete trimstone and facing stone.		
Placing precast concrete units, piles—see Piles, precast, driving of.		
Placing precast concrete units, trimstone—see Concrete trimstone and facing stone.		
Placing reinforcement—See Reinforcement, placing.		
Placing under water, bags	38	28E
Placing under water, within tidal ranges	38	28B
Placing under water, bucket	38	28D
Placing under water, general requirements	38	28A
Placing under water, tremie	38	28C
Plain joints—see Joints, plain.		
Plaster coats, portland cement stucco—see Stucco, portland cement.		
Pointing cracks (concrete)	39	31A
Pointing joints (old stone masonry)	39	31B
Pointing concrete trimstone and facing stone	45	39F
Ponding	47	45F

Items	Page	Paragraph
Portland cement storage, elevated bins	28	6F
Portland cement storage, general requirements	28	6B
Portland cement storage, materials in general	28	6A
Portland cement storage, sacks in storehouse	28	6C
Preparation of surface, filling voids	39	30B
Preparation of surface, general requirements	39	30A
Preparation of surface, scratching (to receive coating)	39	30C
Preparation of surface, smooth, hard surface (to receive coating)	39	30D
Proportioning concrete, change of fine and coarse aggregate	34	19J
Proportioning concrete, consistency or workability	34	19E
Proportioning concrete, flow table test	34	19G
Proportioning concrete, increase of cement ratio	34	19I
Proportioning concrete, measuring	34	19C
Proportioning concrete, portland cement	34	19D
Proportioning concrete, rechecking	34	19H
Proportioning concrete, slump test	34	19F
Proportioning concrete, unit of measure (volume)	34	19A
Proportioning concrete, unit of measure (weight)	34	19B
Protection and curing in general	46	41
Protection, cold weather, antifreezing materials	46	43D
Protection, cold weather, approval	46	43C
Protection, cold weather, general requirements	46	43A
Protection, cold weather, general requirements (portland cement stucco)	46	43B
Protection, cold weather, maximum temperature of concrete	46	43E
Protection from heat, wind and rain, by earth or straw cover (pavements)	46	42B
Protection from heat, wind and rain, by sand or sawdust cover	46	42C
Protection from heat, wind and rain, by tarpaulins	46	42A
Protection from heat, wind and rain, by wetting cover	46	42D
Protection after setting, concrete trimstone and facing stone	45	39G
Protection of piles, precast, while driving	39	29C
Protection from service, barricades (pavements)	46	44A
Protection from service, crossings (pavements)	47	44B
Protection from service, time (tanks)	47	44C
Protective concrete covering—see Covering, concrete.		
Protective facings	48	47
Protective treatments	48	47
Rain, protection from	46	42
Rate of penetration, driving concrete piles	39	29E
Rechecking proportions	34	19H
Reinforcement, bending	32	14B
Reinforcement, cleaning	32	14A
Reinforcement, concrete covering over—see Covering over steel.		
Reinforcement, covering of, in footings	33	15A
Reinforcement, fire-protective covering for	33	15B
Reinforcement, future bonding	33	14L
Reinforcement, lap of bars (pavement)	32	14I
Reinforcement, lap of fabric	32	14J
Reinforcement, minimum covering	33	15
Reinforcement, offsets in compression members	32	14K
Reinforcement, placing fabric (one-course pavement)	32	14E
Reinforcement, placing fabric (two-course pavement)	32	14F
Reinforcement, spacing	32	14G
Reinforcement, splicing in general	32	14H
Reinforcement, straightening	32	14C
Reinforcement, supporting	32	14D

Items	Page	Paragraph
Removal temporary forms, general requirements	29	8G
Retempering concrete	36	23
Rodding concrete	38	27B
Roller, weight of (pavements)	27	4G
Roofing tile, placing	51	53
Roofing tile, general requirements	51	53A
Roofing tile, guarantee of watertightness	52	53F
Roofing tile, large (definition)	52	53C
Roofing tile, large, laying	52	53E
Roofing tile, small (definition)	52	53B
Roofing tile, small, laying	52	53D
Rough cast or spatter dash finish	44	38J
Rub finish	43	38C
Rubble aggregate, placing	37	26N
Sand blast finish	44	38E
Sand floated finish	44	38G
Sand sprayed finish	44	38L
Scarifying (old roadbed of gravel or macadam to receive new pavement)	27	4C
Scratching surface (to receive coatings)	39	30C
Screeding (pavement)	37	26K
Scrubbed finish	44	38D
Seawater, placing concrete in	38	28B
Service, protection from—see Protection from service.		
Setting, concrete trimstone and facing stone	45	39D
Setting, concrete trimstone and facing stone (in monolithic concrete construction)	45	39E
Sewer pipe, laying	50	52
Sewer pipe, backfilling	51	52H
Sewer pipe, excavation (general)	50	52B
Sewer pipe, general requirements	50	52A
Sewer pipe, inspection, visual	51	52E
Sewer pipe, jointing	51	52G
Sewer pipe, laying	51	52F
Sewer pipe, preparation of trenches	50	52C
Sewer pipe, protection after laying	51	52I
Sewer pipe, removal of water from trench	51	52D
Sheet piling and shoring	26	2C
Shoring and sheet piling	26	2C
Shoulders (pavements)	27	5E
Sleeves in concrete	33	17
Sliding forms	29	8F
Sliding joints, seats for	30	10I
Slump test	34	19F
Smooth finish	44	38B
Sockets in concrete	33	17
Spacing of reinforcement	32	14G
Spading concrete	38	27B
Special protective treatments, oilproofing	49	50A
Splicing of reinforcement	32	14H
Sponge finish	44	38K
Spouting concrete	36	25B
Sprinkling	47	45E
Steel tile fillers	29	9C
Stippled finish	44	38H
Storage of materials, aggregates, general	28	6D
Storage of materials, dry concrete materials (elevated bins)	28	6F

Items	Page	Paragraph
Storage of materials, materials in general	28	6A
Storage of materials, portland cement in general	28	6B
Storage of materials, portland cement in sacks in storehouse	28	6C
Storage of materials, concrete trimstone and facing stone	45	39B
Stucco, portland cement, furring and lathing—see Furring and lathing.		
Stucco, portland cement, backplastering (metal lath)	43	36G
Stucco, portland cement, finish coat	43	36H
Stucco, portland cement, first coat (masonry)	42	36B
Stucco, portland cement, first coat (metal lath)	43	36C
Stucco, portland cement, general requirements	42	36A
Stucco, portland cement, hair or fibre, in first coat	43	36D
Stucco, portland cement, quality of base—see Base, quality.		
Stucco, portland cement, second coat	43	36E
Stucco, portland cement, second coat of (double coat work)	43	36F
Sub-base and subgrade—see Subgrade and sub-base.		
Subgrade and sub-base, compacting and wetting	27	4F
Subgrade and sub-base, definition	27	4A
Subgrade and sub-base, scarifying	27	4C
Subgrade and sub-base, subgrade material	27	4B
Subgrade and sub-base, weight of roller (pavement)	27	4G
Supporting reinforcement	32	14D
Supporting metal forms (pavement)	29	8C
Supporting wood forms (pavement)	29	8B
Surface finishes—see Finishing wear surfaces; also Decorative finishes.		
Surface preparation of—see Preparation of surface.		
Surface trueness of finished (pavements)	46	40A
Tamping concrete	38	27B
Temperature, surrounding air during placing in cold weather	46	43A
Temperature, concrete, cold weather	46	43E
Terrazzo course (Type No. 1) finishing	40	33A
Terrazzo course (Type No. 1) placing	40	32C
Terrazzo course (Type No. 2) finishing	40	33B
Terrazzo course (Type No. 2) placing	40	32D
Test, compression	36	24
Tests, final, absorption test (products)	54	55G
Tests, final, absorption test, requirements (concrete block and tile)	54	55H
Tests, final, absorption test, requirements (concrete brick)	54	55I
Tests, final, compression (products)	53	55D
Tests, final, number of specimens (products)	53	55C
Tests, final, required by Architect or Engineer	53	55B
Tests, final, required by local ordinances	53	55A
Tests, final, strength requirement (concrete block or tile)	54	55E
Tests, final, strength requirements (concrete brick)	54	55F
Tests, final, miscellaneous	54	55K
Tests, final, water test (water storage structures)	54	55J
Tests, flow table	34	19G
Tests, slump	34	19F
Tests, specimens, for compression test	36	24C
Tests, specimens, number from first batches	36	24A
Tests, specimens, number from later batches	36	24B
Thimbles in concrete	33	17
Tile, concrete building—see Building block and tile.		
Tile, drain (laying of)	50	51
Tides, placing concrete between	38	28B
Tooled finish	44	38F

Items	Page	Paragraph
Transporting concrete, general requirements	36	25A
Transporting concrete, spouting	36	25B
Transverse construction joints (pavements)	31	13E
Transverse expansion joints (pavements)	30	10F
Treatment, forms	28	7C
Treatment, forms (block, brick, etc.)	28	7D
Treatment, special protective, general	48	47A
Treatment, special protective (oilproofing)	49	50A
Trimstone, placing of—see Concrete trimstone and facing stone.		
Tying, temporary forms	29	8A
Types of concrete or mortar, position in structure	34	18B
Types of concrete or mortar, to be used in structure	33	18A
Vertical fluidtight joints	31	12B
Wall and column forms, removal	29	8G
Water, measuring	34	19C
Water pressure, relieving (vent pipes)	26	3B
Waterproofing, general requirements	48	47A
Waterproofing, integral	49	48G
Waterproofing, membrane, protection of (concrete wall)—see Membrane waterproofing.		
Waterproofing membrane, protection of (mortar coat)—see Membrane waterproofing.		
Waterproofing membrane, (watertight basements)—see Membrane waterproofing.		
Water, removal	26	3A
Water test (water storage structures)	54	55J
Watertight joints—see Joints, fluidtight.		
Wear Course, finishing—see Finishing wear course.		
Wear Course, general requirements	40	32A
Wear Course, terrazzo course (Type No. 1)	40	32C
Wear Course, terrazzo course (Type No. 2)	40	32D
Wear Course, time of placing	40	32B
Wetting and compacting subgrade and sub-base	27	4F
Wind, protection from—see Protection, heat, etc.		
Wood forms—see Forms.		

SPECIFICATIONS

FOR

PLAIN AND REINFORCED CONCRETE

PART III—CONSTRUCTION

1. GENERAL REQUIREMENTS.

Unless otherwise designated construction shall be as specified in this section.

2. EXCAVATION.

2A. Dimensions.

Excavation shall be made to the proper dimensions and elevations, making necessary allowance for forms and other operations required to complete the concrete work.

2B. Soil Bearing Test.

Soil shall be tested to determine its supporting capacity. The tests shall be made in the following manner: ..... The costs of making the tests shall be paid for by the .....

2C. Sheet Piling and Shoring.

Sheet piling and shoring shall be so constructed that they will not pass through the concrete and thus leave openings which must later be filled.

2D. Cofferdams.

Cofferdams shall be sufficiently tight to prevent the flow of water through the space in which concrete is being deposited. Pumping from the inside of the forms will not be permitted while concrete is being placed or until it has fully hardened. This shall not be construed as prohibiting pumping from a curbed sump.

2E. Depth (*Foundations*).

Unless otherwise specified excavation for foundations shall be carried down to firm material and below frost line.

3. DRAINAGE.

3A. Removal of Water.

Water shall be pumped from excavations before the concrete is deposited, or shall be removed by other equally effective means.

3B. Relieving Water Pressure (*Vent pipes*).

Water seeping into forms shall be vented through pipes or otherwise to prevent water pressure against freshly placed concrete. Such pipes must be completely sealed in an approved manner after the concrete has hardened sufficiently to resist the water pressure.

3C. Tile Drain (*Heavy soil having poor natural drainage*).

A line of drain tile shall be placed around the outer lower edge of the wall footings and also under the floors as indicated on the plans.

3D. Drains (*Curb and gutter*).

In poorly drained ground where, in the opinion of the Engineer, it will be necessary to protect the concrete from damage by frost action, concrete tile drains of at least 4-inch diameter shall be laid to the lines and grades established by him.

4. SUBGRADE AND SUB-BASE.

4A. Definition.

The subgrade is the finished surface of the excavation. The sub-base is the layer of material of quality other than that in the subgrade and placed between the concrete slab and the subgrade. When no sub-base is indicated the subgrade must act and be treated as such.

4B. Subgrade Material.

All soft, spongy or yielding spots and vegetable and other perishable matter shall be entirely removed and the space refilled with sand, gravel or other equally suitable material.

4C. Scarifying (*Old roadbed of gravel or macadam for new pavement*).

The old roadbed shall be entirely loosened and the material spread the full width of the roadbed. Interstices shall be filled with fine material of suitable quality.

4D. Subgrade (*Pavement*).

The subgrade will be considered as that portion of the road upon which the pavement is to be placed.

All suitable materials removed from the excavation in fine grading shall be used as far as practicable in the formation of the embankment, as necessary. When the amount of embankment exceeds the amount of material available from excavation, suitable material shall be obtained by the contractor from borrow pits located beyond the limits of the shoulders or embankment slopes.

4E. Subgrade, Pavement (*Special treatment*).

(*Note:* Special treatment may be specified by the Engineer for certain subgrades such as sand, gumbo, adobe, and other materials, which cannot be satisfactorily prepared for pavement by the methods specified herein.)

4F. Compacting and Wetting Sub-Base.

The sub-base shall be thoroughly wet down and brought to a uniform and firm density by rolling or tamping.

Hauling or other traffic over sub-base shall be distributed over the full width of the sub-base so far as practicable in order to maintain a uniformly compacted condition. The sub-base after being prepared as above shall be so maintained until the concrete has been placed thereon.

Before placing concrete an amount of water shall be sprinkled on the sub-base that will be readily absorbed. Under no circumstances shall there be pools of standing water.

4G. Weight of Roller (*Pavements*).

The subgrade shall be rolled to a uniform density with a self-propelled roller, weighing at least 3 tons. All portions of the surface which are inaccessible to the roller shall be thoroughly tamped with a hand tamp having a face area less than 100 square inches and weighing at least 50 pounds.

4H. Sub-Base (*Curb and gutter*).

Where drains are impracticable and the soil is heavy colloidal clay or adobe, a 5-inch sub-base shall be constructed of cinders, gravel or other porous materials approved by the Engineer. The sub-base shall be tamped until the surface is firm and of a uniform bearing power.

5. BACKFILL.

5A. Time of Placing (*Other than structures resisting fluid pressure*).

Backfill shall not be placed against concrete until at least ..... days after it has been deposited.

5B. Time of Placing (*Structures resisting fluid pressure*).

Backfill shall not be placed until after the water test has been made or until 4 weeks after the concrete has been deposited.

5C. Application (*Arches*).

Spandrel filling against arches shall be deposited in such a manner that the arch will be loaded symmetrically. Filling operations shall not be commenced until at least four weeks after the concrete in the arch ring has been placed.

5D. Compacting.

Backfilling shall be placed in well tamped horizontal layers not over 1 foot deep. Care shall be taken to avoid wedge shaped sections against concrete work.

5E. Shoulders (*Pavements*).

After completion of the concrete pavement, the earth shoulders shall be shaped and built to conform with the cross-section shown on the plans.

6. STORAGE OF MATERIALS.

6A. Materials in General.

Materials shall be stored in such a manner that their original qualities will be maintained.

6B. Portland Cement (*General requirements*).

The portland cement shall be carefully protected against dampness until used.

6C. Portland Cement (*Sacks in storehouse*).

The portland cement shall be stored in a storehouse that is weatherproof and has a tight floor more than one foot above the ground. The sacks of cement shall be piled in alternate header and stretcher courses not closer than 6 inches from the inside surface of the outside walls. For storage under 60 days the piles shall be under 12 courses high, and for storage over 60 days, they shall be under 7 courses. Cement shall be used in rotation as received.

6D. Aggregates (*General requirements*).

Each kind of aggregate shall be separately stored and in such a manner as to prevent mixing with each other and to avoid the inclusion of foreign materials. Frost, ice, and lumps of frozen materials shall be removed before aggregates are used.

6E. Aggregates. Storage on Subgrade (*Pavement*).

Both fine and coarse aggregates for the concrete may be delivered and stored directly on the subgrade, provided, however, that no material shall be deposited until the subgrade has been shaped and brought to a true finish. Care shall be taken in removing aggregates from the subgrade that no clay nor earth is taken. Stone forks, approved by the Engineer, shall be used in removing the coarse aggregate from the subgrade.

6F. Dry Concrete Materials (*Elevated bins*).

Dry concrete materials shall be stored in elevated bins having suitable feeding and measuring devices, so placed that they can be drawn off directly into the mixers or into the batch cars or skips as desired.

7. FORMS IN GENERAL.

7A. General Requirements.

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated by the plans. Forms shall be substantial and sufficiently tight to prevent leakage of mortar.

7B. Cleaning.

Before using forms they shall be thoroughly cleaned and all nails removed.

7C. Treatment.

The inside of forms shall be coated with nonstaining mineral oil or other approved material or thoroughly wetted (except in freezing weather). Where oil is used it shall be applied before the reinforcement is placed.

7D. Treatment (*Block, brick, etc.*).

Face plates for rough faces (exposed aggregate) or common brick may be oiled with a mixture of about 4 parts kerosene and 1 part "summer block" lubricating oil or the plates may be heated to prevent sticking of concrete.

For fine faces, the face plates may be treated with one of the following:

(a) Thin soft soap solution.
(b) Lard oil.
(c) Paraffin oil.

7E. Inspection.

Immediately before concrete is placed all forms shall be carefully inspected to be sure that they are properly placed, sufficiently rigid, thoroughly clean, properly treated, and free from snow and ice and other foreign materials.

7F. Strength of Centering.

Centers for forms shall be so constructed that they will not deflect under the weight of wet concrete and any other loads incident to construction.

7G. Approval of Falsework or Centering (*Designed by contractor*).

The contractor shall submit plans of the falsework or centering he proposes to use. These plans shall show sufficient details to enable the Architect or Engineer to judge of its adequacy.

7H. Removal of Centering and Shores.

Centering and shores shall not be removed for at least 28 days and until all excess construction load has been removed.

7I. Forms (*Block, brick, structural tile, etc.*).

Any standard type of concrete block (or brick, etc.) machine, requiring hand or machine tamping, may be used provided that the product produced will in all respects conform to the "Standard Specifications for Concrete Building Block and Concrete Building Tile" of the American Concrete Institute.

7J. Forms (*Sewer pipe, conduit, drain tile, etc.*).

Forms for ..... shall be made in such a manner as to obtain smooth ends and inner surface and insure a product of uniform thickness throughout.

8. TEMPORARY FORMS.

8A. General Requirements.

Forms shall be properly tied together. Bolts and rods shall preferably be used for internal ties, which shall be so arranged that when the forms are removed no metal shall be within one inch of any surface. Wire ties will be permitted only on light and unimportant work, and they shall not be used through surfaces where discoloration will be objectionable.

8B. Supports for Wood Forms (*Pavement*).

Forms shall rest upon stakes driven into the ground within one foot of each end of each separate piece, and at intervals of at least 5 feet. Forms shall be held in place by stakes driven into the ground along the outer edge at intervals of at least 6 feet. Two stakes shall be placed at each joint. The forms shall be nailed to the side stakes.

8C. Supports for Metal Forms (*Pavement*).

Metal forms shall be supported at intervals of at least 5 feet.

8D. Height (*Pavement without curb*).

The upper edges of side forms shall conform to the established grade of the road.

8E. Height (*Pavement with curb*).

The upper edges of side forms shall conform to the top of the curb.

8F. Sliding Forms.

Sliding forms shall be raised at such a rate that the concrete which will be exposed on raising the forms has hardened sufficiently to sustain the weight of the concrete above.

8G. Removal (*General requirements*).

Forms shall not be disturbed until the concrete has adequately hardened. Wall and column forms shall be left in place until the concrete has hardened sufficiently to sustain its own weight and the construction loads likely to come upon it. Forms other than wall or column forms shall be left in place until the concrete has hardened sufficiently to carry the full load which it must sustain, unless removed in sections and each section of the structure is immediately reshored.

9. PERMANENT FORMS.

9A. General Requirements (*Floors*).

All floor fillers shall be accurately spaced so as to obtain the exact width of concrete joists as shown on the plans. Care must be taken to see that the exact length of joists, as determined by the width of beam tee, is maintained.

9B. Structural Concrete Tile Fillers.
(To be supplied by Architect or Engineer.)

9C. Steel Tile Fillers.
(To be supplied by Architect or Engineer.)

9D. Gypsum Tile Fillers.
(To be supplied by Architect or Engineer.)

9E. Hollow Clay Tile Fillers.
(To be supplied by Architect or Engineer.)

10. EXPANSION AND CONTRACTION JOINTS.

10A. General Requirements.

Reinforcement shall not extend across a joint. The break between the two sections shall be complete. Joints shall be filled with a joint filler as hereinbefore specified under materials. All joints shall be made at right angles to the finished surface. Joints shall be placed as indicated by the plans and these specifications.

10B. Location (*Sidewalks*).

One half-inch joints shall be made at right angles to the center line of the sidewalk at approximately 50-foot intervals; also between the sidewalk and the curb or building.

One-inch joints shall be placed at right angles to the center line of the sidewalk when the sidewalk line intersects a curb line or another sidewalk.

10C. Between Pavement and Rigid Structures.

Joints shall be formed between the pavement under construction and all other rigid types of pavement, or adjacent structures.

10D. Alignment (*Pavement with integral curb*).

In pavements with integral curb the joint shall be continuous in one straight line through pavement and curb.

10E. Forming (*Sidewalks*).

The joint shall be made by placing the specified joint filler in place before concrete is deposited.

10F. Transverse (*Pavement*).

Transverse expansion joints shall be ..... inches wide and spaced ..... feet apart. A bulkhead cut to the exact cross-section of the pavement shall be securely staked in place at right angles to the center line of the surface of the pavement. The premolded joint filler shall then be placed against the bulkhead and held in position by pins on which there is an outstanding lug. The concrete shall be deposited on both sides of the bulkhead before it is removed. After the concrete has been struck off the bulkhead shall be removed by lifting it slowly from one end and replacing it with concrete as it is lifted, so that the joint filler will be left in the correct position. When expansion joints are made at the end of the day's work they shall be formed by finishing the concrete to the bulkhead. When placing of concrete is resumed the joint filler shall be placed against the hardened concrete and held in position by pins until the fresh concrete is placed against it. Joints shall be opened on the edges for their entire depth upon removal of the forms.

10G. Longitudinal (*Pavements*).

Longitudinal expansion joints indicated on the plans shall be ..... inches wide. They shall be formed by placing the filler against the form, bulkhead, or adjacent structure and then placing the fresh concrete against it. The filler shall extend the full depth of the pavement and be flush with the finished surface.

10H. Trimming Joint Filler.

Before the pavement is opened to traffic the joint filler shall be cut off to a uniform height of ¼ inch above the finished surface.

10I. Seats of Sliding Joints.

The seat of sliding joints shall be finished with a smooth trowelled surface and shall not have the superimposed concrete placed upon it until it has thoroughly hardened. (See plans for details of joint.)

10J. Crosswise of Structure.

Crosswise joints shall be located and constructed as shown on the plans. (See Appendix II.)

11. PLAIN JOINTS.

11A. Forming (*Plain concrete slabs*).

The joints shall be located and constructed as shown on the plans. (See Appendix II.)

11B. Between Floor Slab and Wall (*Plain concrete*).

The joints shall be located and constructed as shown on the plans. (See Appendix II.)

11C. Division Plates.

Where division plates are used they shall not be removed until the concrete has hardened sufficiently to avoid breaking the edges or corners of the slabs.

11D. Between Pavement and Separate Curb.

A longitudinal joint at least ..... inch in width shall be formed between the separate curb and pavement and filled in a manner as described for longitudinal expansion joints.

12. FLUIDTIGHT JOINTS.

12A. Horizontal.

If walls and floor are not deposited in one operation an approved joint or dam shall be provided between the floor and walls. It shall preferably be constructed as follows:

(1) Provide a recess in the floor to engage the wall and insert a galvanized iron strip at least 10 inches wide with joints riveted and soldered so as to form a continuous band on one side of the recess.

(2) Place a 10-inch strip of deformed galvanized sheet metal one inch back from the inside form and engaging the floor and wall equally. After the wall form is removed, plaster up the 1-inch recess with a 1:1½ mortar and form a 6-inch coved base.

(*Note:* The Architect or Engineer should omit one of the two suggested methods.)

12B. Vertical.

In vertical joints, the form of water-stop shall be as shown on the plans. (See Appendix II.)

13. CONSTRUCTION JOINTS.

13A. General Requirements.

Unless otherwise specified or indicated on the plans, construction joints shall be so located and formed as to least impair the strength and appearance of the structure. All excess water shall be removed from the surface immediately after depositing of concrete has ceased, in order to reduce the laitance. About two hours after stopping work the entire surface shall be roughed and all laitance shall be removed. Before depositing concrete on resumption of work, the surface shall be slushed with water, thoroughly cleaned with stiff brooms and painted with a neat cement grout having the consistency of thick cream. When the mixture is a harsh one an inch of mortar of same proportions as mortar in the concrete should then be deposited in order to avoid stone pockets at the joint.

13B. Columns.

Main construction joints in columns shall be made at the under side of the floor.

Haunches and column capitals shall be considered as part of, and to act together with, the floor construction.

At least two hours must elapse after depositing concrete in the columns before depositing in the floor is commenced.

13C. Reinforced Concrete Floor Slabs. Beams and Girders.

Construction joints in reinforced concrete floors shall be at right angles to the main reinforcement and located near the center of spans of slabs, beams, and girders. If a beam intersects a girder at this point, the joints in the girders shall be offset a distance equal to twice the width of the beam. In such cases adequate provision shall be made for shear by sufficient, inclined reinforcement.

13D. Joints Crosswise of Building.

Crosswise joints shall be located and constructed as shown on the plans. (See Appendix II.)

13E. Transverse (*Pavement*).

Transverse construction joints shall be formed, except at expansion joints, whenever it is necessary to stop placing of concrete for more than 30 minutes, by staking in place a bulkhead and finishing the concrete to it. An edging tool shall be used along the bulkhead to make the construction joint a well defined line. This bulkhead shall have a line of holes spaced 3 feet on centers and 3 inches below the finished pavement. Rods of ¾-inch steel, 4 feet long shall be placed through the holes, leaving 2 feet projecting. The above rods shall be encased in heavy paper or coated with paint or oil in such a manner as to prevent a bond between the steel and concrete. When work is resumed the bulkhead shall be removed, care being taken not to disturb the rods and the concrete. The fresh concrete shall be placed directly against the face of the concrete previously laid and carefully worked around the projecting rods.

If the concrete work must be stopped within 10 feet of a previously made transverse joint the concrete shall be removed to this joint.

13F. Longitudinal (*Pavement*).

Longitudinal construction joints shall be made straight and vertical. When so indicated on the plans, steel dowels shall be provided as for transverse construction joints in paragraph 13E.

13G. Longitudinal Concealed Metal Joint (*Pavement*).

A concealed metal joint shall be placed in the center of the concrete pavement as shown on the plans. The joint shall be deformed in section similar to the detail drawing. Adjoining metal strips shall be lapped 2 inches and securely fastened together by means of ⅜-inch pins driven through matched holes in the splice. The metal joint shall be accurately staked to line and grade by means of pins (left in place) driven vertically through holes provided for that purpose in the metal, at not to exceed 3 feet 4 inches on centers. Punched or cut holes shall be provided in the joint at not to exceed 5-feet centers to receive the ½-inch round deformed tie bars. A template, approved by the Engineer, shall be used to place the metal joint in horizontal and vertical alignment prior to the depositing and finishing of the concrete, and care must be exercised not to displace the joint during the finishing operations.

13H. Horizontal (*Walls*).

Stones shall be embedded to project from the surface or mortises or keys formed in the concrete. Surfaces of contact shall be cleaned and wetted before depositing of concrete is resumed, and any laitance that may then be present shall be removed.

14. REINFORCEMENT.

14A. Cleaning.

When metal reinforcement is placed in the forms it shall be free from excessive amounts of mill and rust scale, and of coatings of any character that will destroy or reduce the bond. Reinforcement appreciably reduced in cross-section shall be rejected. Where there is delay in depositing concrete, reinforcement shall be reinspected and, when necessary, cleaned.

14B. Bending.

Reinforcement shall be formed to the dimensions indicated on the plans or called for in the specifications. The diameter of cold bends shall be four (4) or more times the least diameter of the bar. Hooks shall be bent to a diameter not less than six (6) times the bar diameter.

14C. Straightening.

Metal reinforcement shall not be bent nor straightened in a manner that will injure the material. Bars with kinks, or bends not shown on the plans, shall be rejected. When heating of the bars is authorized by the Architect or Engineer, the entire operation shall be subject to his approval.

14D. Supporting.

Metal reinforcement shall be accurately positioned and, unless otherwise specified or shown on the plans, it shall be secured against displacement by using at the intersections, annealed iron wire, not less than No. 18 gauge, or suitable clips, and shall be supported by concrete or metal chairs, or spacers, or by metal hangers.

14E. Placing Fabric (*One-course pavement*).

Steel fabric shall be placed parallel to the finished surface of the pavement.

14F. Placing Fabric (*Two-course pavement*).

Fabric shall be placed between the base and wearing courses.

14G. Spacing.

Bars shall be spaced as indicated on the plans. (See Appendix II.)

14H. Splicing, in General.

Splicing of reinforcement shall be avoided if possible at points of maximum stress. Splices where permitted, shall provide a lap of at least 40 diameters of the larger bar. At splices the bars shall be separated at least 1½ diameters of the larger bar. Adjacent splices shall not overlap.

14I. Lap of Bars (*Pavements*).

Bars shall be lapped at least 12 diameters of the bar.

14J. Lap of Fabric.

Laps of fabric shall be at least three-fourths of the spacing of the members in the direction lapped.

14K. Offsets in Compression Members.

Where changes in the cross-section of a compression member occur, the longitudinal reinforcement bars shall be sloped for the full length of the member or offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion from the axis of the member shall not be more than 1 inch in 6 inches.

14L. Future Bonding.

Exposed reinforcement required for bonding with the future extension indicated on the plans shall be protected from corrosion.

15. CONCRETE COVERING OVER STEEL REINFORCEMENT AND OTHER EMBEDDED STEEL.

15A. Footings and Walls.

Steel in wall and column footings shall have a minimum covering of 3 inches of concrete. At surfaces of concrete exposed to the weather, steel shall be protected by at least 2 inches of concrete.

15B. Fire Protection (*First class aggregates*).

If a concrete covering containing aggregates which show an expansion not materially greater than that of calcareous or traprock aggregate is used, then such covering shall be at least 1 inch over steel in slabs and walls, and at least 2 inches over steel in beams, girders, and columns.

15C. Fire Protection (*Second class aggregates*).

If concrete containing aggregates which show an expansion materially greater than calcareous or traprock aggregate is used, then the covering shall be at least 2 inches over steel in slabs and walls, and at least 3 inches over steel in beams, girders, and columns.

15D. Fire Protection (*Ordinary*).

In structures where the fire hazard is limited the steel shall be protected by at least ¾ inch of concrete in slabs and walls and by at least 1½ inches in beams, girders and columns.

15E. Concrete Exposed to Alkali Soils or Alkali Water.

The steel shall have a minimum covering of 2 inches of concrete.

15F. Concrete Exposed to Sea Water.

The steel shall be placed at least 3 inches from any plane or curved surface. At corners steel shall be placed at least 4 inches from all adjacent surfaces. Steel chairs, supports, and ties shall not extend to the surface of the concrete.

15G. Pavements.

Steel reinforcement shall be placed at least 2 inches in the clear from the finished surface and shall extend to within 2 inches of the sides and ends of the slabs.

5H. Vaults (*Bank*).

Where steel rails or layers of reinforcing bars are used in the floor, walls and roof, the steel shall in no place be less than 3 inches from the surface of the concrete.

16. NOTIFICATION OF OTHER CONTRACTORS.

As soon as the reinforcement is ready and before concrete is placed this contractor shall notify all contractors whose work is in any way connected with or influenced by the concrete work, and give them reasonable time to complete all portions of their work that must be placed before concrete is deposited in the forms.

17. INSERTS AND ATTACHMENTS.

The contractor shall build into the concrete: collars, sleeves or thimbles required for piping and wirings; anchors, sockets, or inserts for supporting piping, fixtures, or attachments; nailing blocks and strips; bond ties; corner guards; hanging wires or bars for supporting metal ceilings, or fixtures; and all other items required in the specifications or indicated on the plans.

18. TYPES OF CONCRETE AND MORTAR.

18A. Table of Types of Concrete to be Used.

(*Note:* This table should give for each type of concrete proposed for use:

(1) Ultimate Strength at the end of 28 days.

(2) Consistency or work ability of the concrete expressed in terms of slump.

(3) Limits of the grading of the fine and coarse aggregates.

(4) Proportions of cement and aggregates required.

(5) Exact quantities of cement and aggregates required for each cubic yard of concrete. (Allowances for waste, etc., must be made.)

18B. Position in Structure.

The position of the above types of concrete in the structure shall be as follows:

(To be supplied by Architect or Engineer.)

19. PROPORTIONING CONCRETE.

19A. Units of Measure (*Volume*).

Each of the constituent materials shall be measured separately by volume.

19B. Unit of Measure (*Weight*).

Each of the constituent materials shall be measured separately by weight.

19C. Measuring.

The method of measurement shall be such as to secure the specified proportions in each batch.

The consistency of the concrete shall be checked as many times as considered necessary by the Architect or Engineer in order to maintain the required consistency.

After the slump is established, then the water shall be so measured as to insure the same quantity in successive batches of concrete made of the same quality and quantity of aggregate and cement.

19D. Portland Cement.

Ninety-four pounds of portland cement shall be considered as one cubic foot or one-fourth of a barrel.

19E. Consistency or Workability.

The consistency or workability of concrete or mortar shall be measured by the slump test or flow table test in the manner hereinafter specified.

19F. Slump Test.

The newly-mixed concrete or mortar shall be placed in four inch layers in a truncated cone-shaped metal mold, 12 inches high, 4 inches in diameter at the top and 8 inches in diameter at the base. The cone shall be provided with handles on opposite sides. Each layer shall be rodded as placed, 30 times, with a pointed $\frac{5}{8}$-inch steel rod. When the third layer has been rodded and struck off the mold shall be lifted vertically at once.

19G. Flow Table Test.

The consistency or workability of the concrete or mortar may be measured by the flow table test in the following manner:

The newly-mixed concrete shall be placed in a truncated cone 5 inches high; top diameter $6\frac{3}{4}$ inches, and bottom diameter 10 inches; the cone being placed on a metal covered table so designed that the top can be raised and dropped $\frac{1}{2}$ inch. After the mold is filled the concrete shall be rodded and struck off in the same manner as in the slump test; the mold shall be withdrawn and the table raised and dropped 15 times in 10 seconds. The base diameter of the mass of concrete after the test, expressed as a percentage of the original diameter, is the "flow."

A flow of 160 to 180 represents a slump of $\frac{1}{2}$ to 1 inch; one of 210 to 230, a slump of 3 to 4 inches; one of 250 to 270, a slump of 6 to 7 inches; and one of 280 to 300, a slump of 8 to 9 inches.

19H. Rechecking.

The proportions of cement, aggregate and water, specified under *Types of Concrete and Mortar* will give a concrete of a certain strength and workability.

In case the grading of either of the aggregates or the consistency of the concrete vary from those upon which the above proportions were based, then the proportions will be redetermined by the Architect or Engineer.

19I. Increase of Cement Ratio.

Should the Architect or Engineer increase the amount of cement to be used because of the failure of the contractor to conform to the requirements of the specifications pertaining to materials, consistency, mixing, or workmanship, the contractor will not be entitled to additional compensation.

Should the Architect or Engineer, through no failure of the contractor to comply with these specifications, direct an increase in the consistency, then the contractor will not be required to assume the cost of any additional cement which may be required over and above that needed for the tentative type of concrete previously specified under *Types of Concrete and Mortar.*

19J. Change of Fine and Coarse Aggregates.

Proportions of the fine and coarse aggregates may be changed by the Architect or Engineer at any time and the contractor will not be entitled to extra compensation for such change, when the amount of cement required does not exceed that which is required for the types of concrete previously specified under *Types of Concrete and Mortar.*

20. INTEGRAL COMPOUNDS AND ADMIXTURES.

20A. General Statement.

Integral compounds and admixtures are not required if concrete is manufactured with the proper attention to all details and principles in these specifications, regarding the choice of materials, proportions, consistency, mixing, placing, curing, and protection.

20B. Quantity of Hydrated Lime (*Portland cement stucco*).

The amount of lime shall in no case exceed 1/5 the volume of portland cement used.

20C. Intensity of Color.

The amount of pigment to be used shall be such as to produce the proper intensity of color as determined by the Architect or Engineer but shall not exceed the amount hereinafter specified.

20D. Quantity of Pigment.

The weight of pigment shall not exceed 10 per cent of the weight of the portland cement used.

20E. Applying Pigment (*Mortar*).

The pigment and cement shall be mixed together first and then fine aggregate added. The whole shall then be mixed dry by shoveling from one pile to another through a 1/4-inch wire screen until the entire pile is uniform in color.

20F. Applying Hydrated Lime (*Portland cement stucco*).

Hydrated lime shall be carefully measured and added to the dry fine aggregate and cement and then mixed until the whole is of uniform color.

21. MIXING.

21A. General Requirements.

All concrete shall be mixed in a machine except when the Architect or Engineer shall otherwise permit under special conditions. Mixing equipment shall be cleaned at frequent intervals while in use.

21B. Capacity of Mixing Plant.

The mixing plant shall be of sufficient capacity and power to carry out each pre-arranged operation without danger of delay during the process.

21C. Amount of Concrete to Mix.

Only enough concrete shall be mixed that will be placed within 45 minutes.

21D. Amount of Mortar to Mix (*Portland cement stucco, floor topping, and for laying brick, block and trimstone*).

Only enough mortar shall be mixed that will be placed within 30 minutes.

21E. Type of Machine Mixer.

A batch mixer of a type approved by the Architect or Engineer shall be used. The volume of the mixed material used per batch shall not exceed the manufacturer's rated capacity of the drum in cubic feet of mixed material.

The mixer shall be rotated at a peripheral speed of about 200 feet per minute.

21F. Machine Mixing.

The ingredients of the concrete or mortar shall be mixed to the specified consistency. No materials shall be permitted to enter the drum until all the preceding batch has been discharged.

The time of mixing shall be from the time all the materials, including the water, are in the mixer and before any part of the batch is discharged.

21G. Time of Machine Mixing Concrete.

The time of mixing shall be not less than one and one-half minutes.

21H. Time of Machine Mixing Mortar (*Portland cement stucco, floor topping, and for laying brick, block and trimstone*).

The time of mixing shall be not less than 5 minutes.

22. HAND MIXING.

The materials when hand mixed shall be mixed dry on a watertight platform, or in a watertight box until the mixture is of a uniform color, then the required amount of water added, and the materials then turned at least 6 times until the mass is homogeneous in consistency and color.

23. RETEMPERING.

Retempering of concrete or mortar which has partially hardened—that is, remixing with additional water—shall not be permitted. Concrete may be remixed without retempering provided it has not hardened sufficiently to prevent a complete remixing.

24. TEST SPECIMENS.

24A. Number from First Batches.

Six to ten compression test specimens shall be made from the first batches of each type of concrete; one-half of which shall be stored under standard conditions for quality determination and the remainder shall be stored on the job under construction conditions for future testings.

Other specimens shall be made as often as required by the Architect or Engineer.

24B. Number from Later Batches (*In foundations, floors, columns, walls and roof*).

In addition to the foregoing, 3 to 5 specimens shall be made from the concrete entering the foundations, each floor, each story of columns and walls and the roof. The Architect or Engineer may require the preparation of more specimens on account of climatic changes or for any other exceptional reason.

24C. Making Compression Test Specimens.

Compression test specimens of the mixed concrete shall be made in the field in accordance with the current "Standard Methods of Making and Storing Specimens of Concrete in the Field" (Serial No. C31-21) American Society for Testing Materials. All test specimens shall be stored and delivered as directed by the Architect or Engineer. All test specimens shall be made and tested at the expense of the owner unless otherwise specified.

25. TRANSPORTING CONCRETE.

25A. General Requirements.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients.

Transporting equipment shall be cleaned at frequent intervals.

25B. Spouting.

When concrete is conveyed by spouting, the plant shall be of such size as to insure a practically continuous flow in the spout. The angle of the spout with the horizontal shall be such as to allow the concrete to flow without separation of the ingredients. The spout shall have a slope not flatter than 1 vertical to 2½ horizontal.

The spout shall be thoroughly flushed with water before and after each day's run but the water shall not be discharged into the forms. The delivery from the spout shall be as close as possible to the point of deposit. When an operation must be intermittent, then the spout shall discharge into a hopper.

(*Note to Architect or Engineer:* Spouting through a vertical pipe is satisfactory when the flow is continuous; when it is discontinuous it is objectionable unless the flow is broken by baffles.)

26. PLACING.

26A. Approval

All preliminary work shall be carefully checked and the approval of the Architect or Engineer obtained before any concrete is placed.

26B. General Requirements.

Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be deposited in approximately uniform horizontal layers not deeper than 12 inches, care being taken to avoid vertical joints or inclined planes. The piling up of concrete in the forms in such a manner as to permit the escape of the mortar from the coarse aggregate will not be permitted.

26C. Continuous Placing.

Concrete shall be deposited continuously and as rapidly as practicable to insure bonding of the successive layers, and until the unit of operation (as approved by the Architect or Engineer) is completed. Construction joints shall be made as indicated on the drawings or as specified under *Joints.*

26D. Order (*Fluidtight structures*).

Where continuous placing of concrete in the floors and walls is impracticable, the operations shall be carried out in the following order:

a. Footings and floor.
b. Walls.
c. Columns.
d. Roof.

26E. Method (*Arches*).

When it is impossible to deposit concrete continuously in the arch ring, it shall be divided into transverse sections, care being taken that the bulkheads dividing the sections are placed radially. Concrete shall be placed in sections that will nearly balance the load and thrust.

26F. Method (*Pavements, one-course*).

The concrete shall be deposited over the entire width of the section, without the use of intermediate forms or bulkheads between joints.

In case of a breakdown of the mixer, involving stopping operations for more than 40 minutes, a transverse joint shall be formed to close the section at a point directed by the Architect or Engineer.

26G. Method (*One-course slabs, having reinforcement*).

After mixing, the concrete shall be handled rapidly into place. Successive batches shall be deposited in a continuous operation over the entire width of the section, without the use of intermediate forms or bulkheads between joint locations. The concrete shall be placed in two horizontal layers to permit the placing of the steel reinforcement. When the depositing of the first layer has been completed, the surface shall be roughly struck off with a template or screed, riding on the side forms, so as to permit of the placing of the steel reinforcement at the proper elevation. The reinforcement shall then be immediately placed upon and slightly pressed into the fresh concrete. The concreting above the reinforcement shall be resumed within 15 minutes after the lower layer has been placed. Any dust, dirt and foreign matter which collects on the lower layer must be carefully removed before the upper layer is placed.

26H. Method (*Two-course slabs*).

The concrete shall be struck off and tamped to an even surface, the top of which is the thickness of the wearing course below the established elevation of the finished surface. The top course shall be placed as hereinafter specified.

26I. Method (*One-course pavement, having reinforcement*).

When concrete is placed in two horizontal layers to permit the use of steel reinforcement, the first layer shall be roughly struck off with a template or screed, riding on the side forms, at the correct elevation to permit placing the reinforcement in the specified position.

The concrete above the reinforcement shall be placed within 15 minutes after the lower layer is placed. Any dust, dirt and foreign matter which collects on the first layer shall be carefully removed before the upper layer is placed.

26J. Method (*Two-course pavement, with reinforcement*).

The concrete shall be placed as above specified (*Two-course slabs*) and (*One-course pavement, having reinforcement*) except the reinforcement shall be placed upon and slightly pressed into the fresh concrete base before the wearing course is placed.

26K. Screeding (*Pavement*).

The concrete shall be brought to the specified contour by means of a heavy screed or template, weighing not less than 15 pounds per linear foot. This screed or template may be of steel or of wood shod with steel. It shall be shaped to the cross-section of the pavement, and have sufficient strength to retain its shape under all working conditions.

The template or screed shall rest on the side forms and shall be drawn ahead with a sawing motion.

At transverse joints, the template shall be drawn not closer than 3 feet toward the joint. It shall then be lifted and set down at the joint and drawn backwards away from it. Surplus concrete shall be taken up with shovels and thrown ahead of the joint.

26L. Integral Curb.

Immediately after striking off the pavement the concrete for that portion of the integral curb above the gutter line shall be placed.

26M. Thin Wall Sections.

Concrete shall be deposited in forms for walls or other thin sections of considerable height in such a manner as to avoid accumulations of hardened concrete on forms or metal reinforcement.

26N. Rubble Aggregate.

Rubble aggregate shall be thoroughly embedded in the concrete. The individual stones shall not be closer than 4 inches to any surface or adjacent stone. Each successive layer of concrete shall be keyed as specified under *Construction Joints*.

26O. Cyclopean Aggregate.

Cyclopean aggregate shall be thoroughly embedded in the concrete; no stone shall be closer to a finished surface than 12 inches, nor closer than 6 inches to any adjacent stone. Stratified stone shall be laid on its natural bed.

27. PLACING CONCRETE IN AIR.

27A. General Requirements.

When the temperature of the surrounding atmosphere is 40 degrees F. or lower, concrete shall be deposited only by the observance of methods and precautions hereinafter specified.

In no case shall concrete be deposited upon a frozen subgrade or sub-base.

27B. Compacting.

Concrete, during and immediately after depositing, shall be thoroughly compacted by means of suitable tools, rods or forks. For thin walls or inaccessible portions of the forms where the use of tools is impracticable, the concrete shall be assisted into place by tapping or hammering the forms opposite freshly placed concrete. The concrete shall be thoroughly worked around the reinforcement, and embedded fixtures, into all parts of the forms and the coarser particles shall be worked back from the face of the forms.

27C. Bonding.

The surface of the hardened concrete shall be roughened, thoroughly cleaned of foreign matter and laitance, saturated with water and the forms retightened before depositing additional concrete. An excess of mortar on vertical and inclined surfaces shall be obtained by thoroughly working the freshly deposited concrete to remove the coarse aggregate from contact with the hardened concrete.

28. PLACING CONCRETE UNDER WATER.

28A. General Requirements.

Concrete shall not be deposited under water if practicable to deposit it in air.

Concrete shall not be placed in water which has a temperature below 35 degrees F.

The methods, equipment and materials to be used shall be approved by the Architect or Engineer before work is started. Concrete shall be machine mixed.

When placing concrete care must be taken to prevent the washing of cement from the mixture, minimize the formation of laitance, avoid the flow of water within the forms until the concrete has hardened, and prevent the segregation of materials.

The top surface of the concrete shall be kept as nearly level as possible, until it reaches the required height.

28B. Within Tidal Ranges.

Concrete shall be deposited within the limits of high and low tides in one continuous operation. Units and equipment shall be so arranged in advance as to make this possible. The underwater concrete shall be brought up to be 6 inches above low water mark and operations suspended until ebb tide. The forms shall then be dewatered and the concrete deposited in air with sufficient rapidity to keep ahead of the rising tide. The face of the concrete on all sides shall be carefully worked with suitable tools at the time of placing, in order to work back any coarse aggregate and to insure a thick impervious skin. The forms within this range shall be made as nearly watertight as is practicable.

28C. Tremie.

The tremie shall be watertight and sufficiently large to permit a free flow of concrete. It shall be kept filled at all times during the depositing of concrete. The concrete shall be discharged and spread by raising the tremie in such a manner as to maintain as nearly as practicable a uniform flow and avoid dropping the concrete through water. If the charge is lost during placing of concrete, the tremie shall be withdrawn and refilled.

28D. Bucket.

The bucket shall be of a type that cannot be dumped until it rests on the surface upon which the concrete is to be deposited. The bottom doors when tripped shall open freely downward and outward. The top of the bucket shall be open. The bucket shall be completely filled, and slowly lowered to avoid backwash. When discharged, the bucket shall be withdrawn slowly until well above the concrete.

28E. Bags.

Bags of jute or other coarse cloth shall be filled about two-thirds full of concrete and carefully placed by hand in a header-and-stretcher system so that the whole mass is interlocked.

29. DRIVING CONCRETE PILES.

29A. General Requirements.

Concrete piles, as called for on the plans and in these specifications, shall be of a type approved by the Architect or Engineer. Before driving, the piles shall be carefully located and set to the lines called for on the plans. The pile driver leads shall be held in proper position by means of guy lines. Unless otherwise called for on the plans, piles shall be driven in a plumb position. Any pile out of plumb, or having been injured in driving, or having been driven out of place, shall either be replaced by a new pile or pulled out and redriven, as the case may require and as the Architect or Engineer shall direct.

29B. Method of Placing.

Piles shall be placed in position by jetting, driving with a steam hammer, by jacking or by a combination of these methods as the soil conditions may require, or in such specific manner as the Architect or Engineer may direct.

29C. Protection of Piles.

While the piles are being driven, they shall be protected with a cushion cap of a type approved by the Architect or Engineer.

29D. Depth to be Driven.

Jetting operations shall cease before the pile reaches its final position. The pile shall then be sunk to its final position by loading or driving and until the rate of penetration, as determined and specified by the Architect or Engineer, shall have been secured. Piles shall be driven to the depth shown on the plan unless otherwise directed by the Engineer, in which case the contractors' compensation shall be adjusted accordingly.

29E. Rate of Penetration.

(To be determined and specified by the Architect or Engineer.)

30. PREPARATION OF SURFACE.

30A. General Requirements.

The strictest adherence to the details and principles in these specifications regarding the choice of materials, proportions, consistency, mixing and placing shall be maintained, in order to insure a uniform texture of the surfaces to be coated or finished. Placing shall be continuous throughout each distinct division of an area. Joint lines shall be located as indicated on the plans.

30B. Filling Voids.

Voids which appear upon removal of the forms shall be drenched with water, immediately filled with material of the same composition as that used in the surface, and smoothed with a float. Fins and offsets shall be neatly removed and the work finished free from streaks.

30C. Scratching (*To receive coating*).

The surface shall be thoroughly scratched or roughened.

30D. Smooth, Hard Surfaces (*To receive coating*).

If the required coating is to be applied to a smooth, hardened base course of concrete, the latter shall be prepared by roughening with a suitable tool, or by the use of an acid wash treatment.

After roughening, the surface shall be thoroughly cleaned of all dust, dirt and acid and then thoroughly saturated with clean water. It shall be covered with a thin wash of neat cement grout immediately before the coating is placed.

31. POINTING.

31A. Cracks (*Concrete*).

Cracks and joints in the surface shall be cut back to form a groove at least 1 inch deep and then filled with mortar.

31B. Joints (*Old stone masonry*).

Repointing shall not be done in extremely warm or in freezing weather.

All mortar and loose material in joints of old masonry work must be raked out to a depth of at least 1 inch.

After the joints are raked out and brushed clean, they shall be well moistened with water just before the mortar is applied. Mortar made as specified under *Types of Concrete and Mortar* shall then be applied with a small trowel and forced into the joint with pressure until the joint is completely filled. The joint shall be finished in a manner approved by the Architect or Engineer.

32. WEAR COURSE.

32A. General Requirements.

The concrete or mortar used in this course shall be of a type as specified under "Types of Concrete or Mortar."

Unless otherwise indicated by the plans the minimum thickness of this course shall be 1 inch. After placing, this course shall be struck off to a smooth even surface.

After the wearing course has been brought to the established grade by means of a strikeboard, it shall be worked with a wood float in a manner which will thoroughly compact it and provide a surface free from depressions or irregularities of any kind. When required, the surface shall be steel-troweled, but excessive working shall be avoided. A mixture of dry cement, sand and No. 1 Aggregate may be applied to the fresh concrete of the base for a wearing course, but in no case shall dry cement or a mixture of dry cement and sand be sprinkled on the surface of the wearing course to absorb moisture or to hasten the hardening. Special methods not conflicting with these specifications may be used.

(*Note:* No. 1 aggregate for the wearing course shall consist of clean, hard, tough, crushed rock or pebbles, free from vegetable or other organic matter, and shall contain no soft, flat or elongated particles. It shall pass when dry a screen having three-eighths (⅜) inch openings and not more than ten (10) per cent shall pass a screen having four (4) meshes per linear inch.)

32B. Time of Placing.

The wear course shall preferably be placed within ½ hour after the placing of the base course. It may be placed later if the surface of the base course is treated as hereinbefore specified.

32C. Terrazzo Course (*Type No. 1*).

Aggregate as specified under *Materials: Colored Aggregate* shall be used in this course.

32D. Terrazzo Course (*Type No. 2*).

Aggregate as specified under *Materials: Colored Aggregate* for terrazzo finish shall be evenly spread over the surface of the fresh mortar topping to the proper thickness and pressed or rolled in. Enough chips shall be used to cover at least 85 per cent of the surface.

33. FINISHING WEAR SURFACE.

33A. Terrazzo (*Type No. 1*).

After curing and protecting as specified the surface shall be rubbed to the desired finish with an abrasive stone or surfacing machine.

33B. Terrazzo (*Type No. 2*).

After the finish course has hardened somewhat, but before it is too hard, it shall be ground down by a rotary grinding machine or by hand, using an abrasive, to a smooth, even surface, exposing the aggregate on their largest dimensions.

33C. Belting (*Pavement*).

The concrete shall be finished by using a belt of wood, canvas, or rubber, not less than six (6) nor more than twelve (12) inches wide, and at least two (2) feet longer than the width of the pavement. The belt shall be applied with a combined crosswise and longitudinal motion. For the first application vigorous strokes at least twelve inches long shall be used, and the longitudinal movement along the pavement shall be very slight. The second application of the belt shall be immediately after the water sheen disappears, and the stroke of the belt shall be not more than four inches, and the longitudinal movement shall be greater than for the first belting.

33D. Machine Finishing (*Pavement*).

When a finishing machine is used it shall be so designed and operated as to strike off and consolidate the concrete, eliminating ridges and producing a true and even surface. The operation of the machine shall be so controlled as to keep the coarse aggregate near the finished surface of the pavement. Repeated operation of the machine over a given area is to be avoided.

A hand tamping template and belt must be kept for use in case the tamping machine breaks down.

33E. Longitudinal Floating (*Pavement*).

Immediately after the screeding has been completed, the surface shall be inspected for high or low spots and any needed corrections made by adding or removing concrete. Rough spots shall be gone over with a long handled float and worked to proper contour and grade. The entire surface shall then be floated longitudinally, with a float board not less than sixteen feet long and eight inches wide. This float board shall have convenient plow-handles at each end. It shall be operated by two men, one at each end, each man standing on a bridge spanning the pavement. The lower surface of the float board shall be placed upon the surface of the concrete with the long dimension parallel to the center line of the pave-

ment. The float shall then be drawn back and forth in slow strokes about two feet long, and advancing slowly from one side of the pavement to the other. The purpose of this operation is to produce a uniform even surface on the concrete, free from transverse waves. (The two bridges on which the workmen stand should be placed about eighteen (18) feet apart when the length of the float is sixteen (16) feet.) When the entire width of the pavement has been floated in this manner from one position of the bridges, they shall be moved ahead about twelve feet so that the next section to be floated shall overlap the one previously so floated from three (3) to four (4) feet. After this floating has been completed, and all transverse waves eliminated, the surface shall be finished by the belting process specified above.

33F. Finishing at Joints and Edges (*Pavement*).

The contractor shall provide a suitable split float or split roller, having a slot to fit over expansion joints. This device shall be so arranged as to float the surface for a width of at least three (3) feet on each side of the joint simultaneously. This device shall be used in such a manner as to produce a true surface across the joint. Edges of the pavement, at joints and side, shall be tooled for a width of two (2) inches, the corners rounded to a radius of one-quarter (¼) inch.

33G. Finishing at Joints and Edges (*Sidewalks*).

All joints shall be edged to a radius of ⅛ inch. The surface edges of each slab shall be rounded to a radius of about ¼ inch.

Markings shall be exactly at cuts between slabs.

33H. Finishing Adjacent to Integral Curb (*Pavement*).

The concrete for a distance of 18 inches from the curb line shall be finished with a steel trowel; care being taken not to trowel any more than is absolutely necessary.

The top and inside surface of integral curbs shall be given a smooth finish and completed with the pavement to the point of stopping each day's work.

33I. Finishing at Joints (*Walls*).

All joints shall be finished as indicated on the drawings.

34. QUALITY OF BASE (*To Receive Portland Cement Stucco*).

34A. Masonry in General.

All masonry surfaces shall be set in line and shall be roughened or scored to increase the bond of the stucco. Mortar joints shall be cut back at least even with the surfaces.

34B. Monolithic Concrete.

Monolithic concrete walls shall preferably be rough and of coarse texture, rather than smooth and dense. Walls of this type shall be cleaned and roughened, if necessary, by hacking, wire brushing, or other effective means. The surface of the concrete shall be brushed free from all dust, dirt and loose particles, and shall be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

34C. Concrete Block.

Concrete block for stucco walls shall be rough and of coarse texture, but not weak nor friable. Block shall be set with cement mortar joints, which shall be raked out or cut back even with the surface. Before applying the stucco the surface shall be brushed free from all dust, dirt and loose particles, and shall be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

34D. Clay Tile.

Tile for exterior walls shall preferably be not less than 8 inches thick, and shall be hard-burned, with dovetail or heavy ragged scoring. Tile shall be set in cement mortar composed of one part cement, not more than one-fifth part hydrated lime, and three parts sand, by volume. The blocks shall not vary more than ½ inch in total thickness and shall be set with exterior faces in line. Joints shall not be raked, but mortar should be cut back to the surface. Neither wire mesh nor waterproofing of any type shall be applied to tile walls before plastering, nor shall any wooden members (except inserts for nailing) be embedded in masonry walls, particularly where they are to be covered with stucco. The surface of the tile shall be brushed free from all dirt, dust and loose particles, and shall be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

34E. Brick.

Surface brick shall be rough, hard-burned, commonly known as arch brick. Brick shall be set in cement mortar with joints not less than ⅜ inch thick, and the mortar shall be raked out for at least

½ inch from the face. The surface of the brick shall be brushed free from all dust, dirt and loose particles, and shall be wetted to such a degree that water will not be rapidly absorbed from the plaster, but not to such a degree that water will remain standing on the surface when the plaster is applied.

Old brick walls which are to be overcoated, shall have all loose, friable, or soft mortar removed from joints, and all dirt and foreign matter shall be removed by hacking, wire brushing or other effective means. Surfaces that have been painted or waterproofed shall be lathed with metal lath before overcoating.

34F. Framing and Bracing.

Studs spaced not to exceed 16 inches centers shall be run from foundation to rafters without any intervening horizontal members. The studs shall be tied together just below the floor joists with 1x 6-inch boards which should be let into the studs on their inner side, so as to be flush, and securely nailed to them. These boards will also act as sills for the floor joists, which, in addition, should be securely spiked to the side of the studs.

The corners of each wall shall be braced diagonally with 1 x 6-inch boards let into the studs on their inner side, and securely nailed to them.

In back-plastering construction in which sheathing is omitted, at least once midway in each story height, the studs shall be braced horizontally with a 2 x 3-inch bridging set 1 inch back of the outside face of the studs. (This assumes that the studs are 2 x 4 inches. Larger sizes would require correspondingly larger bridging.)

34G. Sheathing (*Wood frame work*).

(a) In back-plastered construction the lath shall be fastened directly to the studding and back-plastered, and no sheathing used.

(b) In sheathed construction the sheathing boards shall not be less than 6 inches nor more than 8 inches wide, dressed on one or both sides to a uniform thickness of 13/16 inch. They shall be laid horizontally across the wall studs and fastened with not less than two 8d nails at each stud. Over the sheathing boards shall be laid in horizontal layers, beginning at the bottom, a substantial paper, well impregnated with tar or asphalt. The bottom strip shall overlap the baseboard at the bottom of the wall, and each strip shall lap the one below at least 2 inches. The paper shall lap the flashings at all openings.

35. FURRING AND LATHING (*Portland Cement Stucco*).

35A. Position of Furring.

Furring shall be placed in a vertical position and directly on or along the line of the studding. On masonry surfaces the furring shall be spaced 16 inches center to center.

35B. Fastening Furring (*Masonry surfaces*).

The furring shall be securely fastened to the masonry surface by means of galvanized wire clips or 6d nails spaced not over 8 inches apart.

35C. Fastening Furring (*Wood sheathing*).

Metal furring shall be placed over the sheathing paper and sheathing at the stud lines and securely nailed to the sheathing with 1½-inch No. 14 galvanized iron staples spaced not more than 8 inches apart. Wood furring shall be fastened with 6d galvanized nails spaced 8 inches apart.

35D. Metal Lath.

Metal lath shall be placed horizontally, fastened to the furring or studding with 1½-inch No. 14 galvanized iron staples spaced not more than 8 inches apart. The staples shall not be driven home but shall allow for about ⅛ inch play of the lath.

Vertical laps of metal lath shall be at supports and securely fastened 4 inches apart. Horizontal joints shall be locked or butted, and tightly laced or tied with 18-gauge galvanized wire. Sheets of metal lath shall be folded around the corners and firmly fastened down. Corner beads shall not be used.

36. PORTLAND CEMENT STUCCO.

36A. General Requirements.

The plastering operation shall be carried on in one general direction without permitting the mortar to dry at the edges. If impossible to finish a full surface at one time, the joints shall be made at some natural division of the surface, such as at a pilaster, door or window. Mortar used in the various coats shall be made as specified under *Types of Concrete or Mortar.*

36B. First Coat (*Masonry*).

This coat shall be well pressed onto the base to obtain a thorough bond and shall have an average thickness of ¼ inch.

It shall be heavily cross-hatched to provide a strong mechanical key for the next coat as hereinafter specified.

36C. First Coat (*Metal lath*).

This coat shall be well pressed into the lath to obtain a perfect key and shall have an average thickness of ¼ inch. It shall then be heavily cross-hatched to provide a mechanical key for the next coat.

36D. Hair and Fibre in First Coat.

Hair or fibre may be used in the first coat where the stucco is applied over metal lath which is to be backplastered and where the metal lath is applied over sheathing and is separated therefrom by furring deeper than ⅜ inch.

36E. Second Coat.

The second coat should be applied whenever possible the day following the placing of the first coat. The first coat shall be dampened but not saturated before the application of the second coat.

The second coat shall be from ⅜ to ½ inch thick and brought to an even surface by frequent testing with a straightedge. When stiff enough it shall be floated with a wooden float and lightly and evenly cross-hatched to secure a good mechanical bond for the finish coat.

The surface shall then be wetted and kept from drying out for at least 3 days.

36F. Second Coat of "Double Coat Work."

In Double Coat Work the "second coat" as above specified shall be applied as soon as the first coat is sufficiently stiff.

36G. Backplastering (*Metal lath*).

The backing coat shall be applied directly after the completion of the second coat. The keys of the scratch coat shall be thoroughly wetted and the backing coat immediately applied to a thickness of from ⅝ to ¾ inches. Backplaster shall be finished at least ¼ inch back of the face of the studding.

36H. Finish Coat.

The finish coat shall be applied not sooner than 7 days after the application of the second coat. The finish coat shall then be brought to a smooth even surface ready to be finished as hereinafter specified.

37. CONCRETE FACING.

37A. Colored Aggregate.

This finish shall be made of concrete as specified under *Types of Concrete and Mortar* using colored aggregates as specified under *Materials*.

37B. Colored Mortar.

This finish shall be made of mortar as specified under *Types of Concrete and Mortar* colored as hereinbefore specified.

37C. Application.

The facing shall be placed against the face forms to a thickness of at least 1½ inches and sufficiently in advance of the body or backing concrete to prevent the latter from displacing the facing material.

37D. Application (*Block, brick and trimstone*).

The colored facing shall be placed against the face plates of the molds to a thickness of at least ⅜ inch and the body or backing concrete placed in such a manner as to prevent displacing of the facing material.

38. DECORATIVE FINISHES.

38A. General Requirements.

The exact design, color, texture and location of the following decorative finishes shall be determined by the Architect or Engineer.

(*Note to Architect or Engineer:* Use only such of the following finishes as are desired.)

38B. Smooth Finish.

The fresh surface shall be trowelled only the minimum amount necessary to produce the desired smoothness and texture. Particular attention shall be paid to curing.

38C. Rub Finish.

Before the surface has hardened it shall be wetted, and rubbed even and smooth with carborundum or other abrasive.

A thin grout consisting of cement and fine sand mixed with water to a consistency of paint shall be applied during the rubbing.

A few hours after work is completed the film of grout shall be removed by washing the surface with clean water.

38D. Scrubbed Finish.

As soon as the surface has hardened sufficiently to prevent injury from finishing operations it shall be scrubbed with stiff fibre or wire brushes and clean water until the aggregate is uniformly and sufficiently exposed.

The surface shall then be cleaned with clear water. The corners shall be sharp and unbroken. To facilitate the scrubbing of surfaces that have become too hard to scrub in uniform relief, dilute hydrochloric acid (1 part of acid to 5 parts of water), may be used. The acid shall be thoroughly washed off with clean water a few minutes after its application.

38E. Sand Blast Finish.

The surface shall be thoroughly hard before sand blasting. It shall then be cut with an air blast using thoroughly dry, clean sharp sand or crushed quartz, until the aggregate is in uniform relief. For ¼-inch nozzles the sand shall pass a No. 8 screen and for ⅛-inch nozzles, a No. 12 screen.

38F. Tooled Finish.

The surface shall be thoroughly hardened before tooling. It shall then be dressed with proper tools to a uniform depth and finish. The work shall be outlined before the operation is started by the use of a sharp chisel and stone cutter's mallet in order to insure straight and true margins.

38G. Sand Floated Finish.

This finish shall be applied before the surface has fully hardened.

Fine sand shall be rubbed into the surface with a wooden float. The resulting finish shall be even and uniform.

38H. Stippled Finish.

This finish shall be obtained by lightly patting the fresh surface with a brush of broom-straw.

38I. Pebble Dash Finish.

Wetted aggregates (as specified under *Materials*) shall be thrown forcibly against the fresh surface so as to embed themselves securely.

The aggregates shall be distributed uniformly over the finished surface and pushed back into the surface with a clean wood float. No rubbing shall be done after the pebbles are embedded.

38J. Rough Cast or Spatter Dash Finish.

A mixture of 1 sack of cement to 3 cubic feet of fine aggregate shall be thrown forcibly against the newly placed surface to produce a rough, uniform texture when viewed from a distance of 20 feet. Special care shall be taken to prevent rapid drying of this finish by thoroughly wetting down at intervals after the surface has hardened sufficiently to prevent injury.

38K. Sponge Finish.

A clean, soft pine float shall be pressed down onto the fresh, even surface and withdrawn, care being taken not to separate the finished surface from that underneath.

38L. Sand Sprayed Finish.

This finish shall be applied before the surface has attained its early hardening.

A mixture of equal parts of cement and sand, having a uniform creamy consistency shall be sprayed on the surface of the base by means of a long fibre brush or whisk broom, using as much force as possible.

(The addition of hydrated lime in quantities not to exceed 10 per cent of the weight of the cement in the mixture may be used if desired in order to produce lighter shades of finish.)

39. CONCRETE TRIMSTONE AND FACING STONE (*Placing of*).

39A. General Requirements.

Setting plans showing arrangement of joints, size and shape of units and bonding to be employed shall be submitted to the Architect or Engineer and shall have been approved by him before any material is delivered on the site.

Ample size lifting rings shall be cast in all units weighing over 150 pounds. Samples of the trimstone and facing stone which the contractor proposes to use in the structure shall be submitted to the Architect or Engineer for approval.

39B. Delivery and Storage.

All concrete trimstone shall be handled by competent workmen. When unloading cast trimstone from cars or trucks care must be used to guard against soiling, marring, and chipping of surfaces and edges. The trimstone, when stored at the construction site for any period of time, shall be stored in such a manner that it will rest entirely clear of the ground, and be protected by proper means from damage to the faces and from contact with anything that would result in marring or staining the surfaces, such as accumulations of dirt, dust, grease, or other disfiguring elements. In no case should the trimstone be placed under trees or other overhanging objects, where damage by stains from drippings may occur. During the period of storage the trimstone must be kept covered with tarpaulins, heavy, nonstaining paper or boards in such a manner that the stone will be protected against rain, wind, sleet, snow and ice.

39C. Mortar.

(*Note to Architect and Engineer:* Mortar shall conform to specifications elsewhere given for sand cement, mixing, etc.)

39D. Setting.

The trimstone must be thoroughly wetted on all jointing faces and then set in a full bed of mortar and tapped to a full and solid bearing. The face of the trimstone shall be kept free from mortar at all times. The units shall be accurately set to line and level. Joints must be plumb and true and the face of the wall free from waves, projections or depressions. All bed and vertical joints shall have a minimum thickness of ¼ inch, unless otherwise specified.

All anchors, dowels, etc., shall be built in and the holes filled with mortar.

The backing shall be built up the same time the trimstone is set.

The trimstone shall preferably be set to position without the use of wooden wedges. If these are used, they must be soaked in water before using and must be removed prior to pointing.

39E. Setting Concrete Stone (*In monolithic concrete construction*).

When cast stone ornaments are embedded in monolithic concrete construction care must be taken to fit the stone accurately and tightly into the forms. Sufficient anchorage must be provided to prevent displacement of cast stone during and after placing of the concrete.

Leakage of concrete through the joint between the forms and the cast stone must be prevented by calking the crevices with oakum or other suitable material.

The cast stone must be protected from spattering or slopping over of the concrete being placed into the forms, by covering with tar paper or tarpaulins. Heavy, nonstaining paper may be inserted in the top joints of the stone and projected and bent over the surface so as to prevent cement drippings onto the exposed faces.

39F. Pointing.

Rake out and clean all joints to a depth of at least ¾ inch. Wash out and thoroughly wet the joint. The pointing mortar must be pushed well back into and completely and solidly fill the joint space previously raked out. The surface of the joints shall be.....(struck, beaded, flush, sunk, etc.) in a manner satisfactory to the Architect or Engineer.

Where stones abut against mullions or jambs, the joints must be carefully caulked with oakum before pointing.

39G. Protection after Setting.

All surfaces, edges, corners, etc., shall be protected after setting by means of suitable wooden edging, surface and corner guards wherever so directed by the Architect or Engineer, and in a manner approved by him.

39H. Defective Work.

No repairing of chipped or damaged units will be permitted except by direction of the Architect or Engineer and then only by skilled mechanics from the company manufacturing the stone, unless otherwise permitted, in which case the repairs shall be made only with material furnished by the concrete stone manufacturer and according to his directions.

39I. Cleaning.

The face of the concrete stone shall be thoroughly cleaned upon completion of the structure. The use of acids will not be permitted for cleaning unless specifically directed by the Architect or Engineer.

When cleaning clay brick, tile or terra cotta work in the structure with acid solution, the concrete trim and facing stone shall be protected from damage from the acid.

40. TRUENESS OF FINISHED SURFACES.

40A. Pavements.

The finished surface of the pavement must conform to the grade, alignment, and contour shown on the plans. Just prior to the final finishing operation, the surface shall be tested with a light straightedge, 10 feet in length, laid parallel to the center line of the pavement. Any deviation shown by this straightedge shall be immediately corrected.

The contractor shall be held responsible for the trueness of surface of the pavement, and shall be required to make good any deviation from the alignment, grade, and contour shown on the plans.

41. PROTECTION AND CURING IN GENERAL.

Freshly placed concrete or mortar shall be protected and cured as hereinafter specified. The method of protection and curing shall be such that the surface of the concrete or mortar will not be injured thereby. Surfaces must be kept moist by sprinkling or spraying during the curing period.

42. PROTECTION FROM HEAT, WIND, AND RAIN.

42A. Tarpaulins.

The surface shall be protected with canvas, burlap or other equally effective covering until the concrete shall have hardened sufficiently to prevent injury from application of covering material.

42B. Earth or Straw Cover (*Pavement and walks*).

The surface shall be covered with at least 2 inches of earth or 6 inches of straw or hay.

42C. Sand or Sawdust Cover.

The surface shall be covered with at least 1 inch of sand or 2 inches of nonstaining sawdust. Oak or hemlock sawdust shall not be used.

42D. Wetting Cover.

The covering shall be kept saturated with water during the curing period.

43. COLD WEATHER PROTECTION.

43A. General Requirements.

The temperature of the concrete shall be maintained at not less than 50 degrees F. for a period of 72 hours after placing. The mixing water and aggregate shall be heated and precautions taken to maintain the specified temperature for the specified period, whenever, in the opinion of the Architect or Engineer the temperature of the air will fall below 40 degrees F. within the next 24 hour period after placing.

43B. Portland Cement Stucco.

No stucco work shall be done when the temperature of the surrounding air is below 40 degrees F. unless the work is covered with tarpaulins and the air underneath is maintained at a temperature of 50 degrees F. or over for a period of 72 hours after placing.

43C. Approval.

The methods of heating the materials and protecting the concrete or mortar shall be approved by the Architect or Engineer.

43D. Antifreezing Compounds.

Salt, chemicals, and other foreign materials shall not be used to prevent freezing except as directed by the Architect or Engineer.

43E. Maximum Temperature of Concrete.

Temperature of concrete at the time of placing shall not exceed 120 degrees F.

44. PROTECTION FROM DAMAGE.

44A. Barricades (*Pavement*).

The contractor shall provide and maintain substantial barricades across the pavement, with suitable warning signs by day and by night, to prevent traffic of any kind upon the pavement before it is.....days old. The contractor shall provide and maintain watchmen at each mixer, whenever the paving crew is not at work, who shall prevent destruction or removal of barricades, and keep traffic off the pavement.

No section of pavement shall be opened to traffic until written instructions have been given by the Engineer.

44B. Crossings. (*Pavements*).

At public highway and private crossings, the contractor shall provide suitable structures to carry the traffic across the pavement without injury to the concrete. All such structures shall be subject to the approval of the Engineer, and he may direct their improvement, or repair, as conditions may require.

44C. Time (*Tanks*).

Tanks shall not be put in service until at least 4 weeks after the placing of the concrete has been completed.

45. CURING.

45A. General Requirements.

Freshly placed or cast concrete, shall be cured as hereinafter specified.

45B. Temperature of Curing.

(a) Temperature of Steam Chamber (*Products*).

The products may be removed to the steam chamber immediately after removal of forms, provided the difference in temperature between the concrete and the steam chamber atmosphere does not exceed 35 degrees F. The temperature may then be gradually increased to 125 degrees F.

(b) Temperature of Spray Chamber (*Products*).

The products may be removed to the spray chamber immediately after removal of forms. Temperatures between 60 degrees F. and 100 degrees F. shall be maintained during the curing period.

(c) Temperature Requirements (*Except products*).

During the period of curing the temperature of the air in contact with the concrete shall be maintained at 50 degrees F. for a period of 72 hours after placing and at 40 degrees or over, during the remainder of the time.

45C. Operating Steam Chamber (*Products*).

The atmosphere in the chamber shall be at all times saturated with water vapor produced by passing steam through perforated pipes placed (perforations down) in a trough of water in the floor, or by equally effective methods.

45D. Operating Spray Chamber (*Products*).

The spray chamber shall be equipped with spray or fog nozzles which shall be operated in such a manner as to keep the entire chamber filled with a mist or fog of water.

The concrete products when first placed in the chamber shall be protected from draughts of air and from all exposure which will tend to cause evaporation of moisture from the products until they have become sufficiently hardened so that the surface will not be injured during sprinkling. The products shall then be constantly sprinkled or sprayed with water.

45E. Sprinkling (*In general*)

The sprinkling system of curing may be used if approved by the Engineer. The sprinkling system shall be arranged, and supplied with water at ample pressure, to keep every portion of the surface continuously wet (both day and night) during the curing period.

45F. Ponding (*Floors, pavements, walks, etc*).

The ponding system of curing shall preferably be used whenever conditions will permit. Dykes shall be built along both edges of the surface with cross-dykes at frequent intervals, and the surface flooded with sufficient water within the dykes to keep all portions of the surface continuously covered with water during the period of curing.

45G Time in Steam Chamber (*Products*).

The products shall be steam cured in the chamber for not less than 24 hours.

45H Time in Spray Chamber (*Products*).

The products shall be sprayed in the chamber for a period of at least 6 days.

45I. Time after Removal from Chamber.

Products after being removed from the chamber shall be stored in the open for a period of at least 14 days or until they have attained the specified strength. During this latter period they shall be sprinkled with water continuously or not less than twice daily.

45J. Time (*Floor, stair, and similar surfaces*).

Concrete surfaces subject to wear such as concrete floors and stair treads, shall be kept wet for a period of at least 10 days after placing.

(*Note to Architect and Engineer:* Whenever conditions shall permit the concrete shall be kept wet for 21 days.)

45K. Time (*Pavement and sidewalk surfaces*).

Concrete road and pavement surfaces shall be kept wet for a period of at least 21 days after placing.

45L. Time (*Surfaces not subject to wear*).

All surfaces not subject to wear shall be cured for a period of.....days after placing and longer if deemed necessary by the Architect or Engineer.

45M. Method (*Concrete tanks*).

A little water shall be placed in the tank as soon as the concrete has sufficiently hardened to prevent undue strain on the concrete. The top of the tank shall then be kept covered during the curing period. The exposed surfaces of the tank shall be kept continuously wet for a period of ten days after placing.

45N. Disposal of Water (*Pavements*).

The contractor will be held responsible for any damage to roadways, shoulders, and adjacent property caused by escaping curing water.

Water shall be led away to ditches or culverts as directed by the Engineer.

46. CLEANING AFTER PROTECTION AND CURING.

46A. General Requirements.

The protective covering shall be removed at the end of the curing period, and the surface thoroughly cleaned.

46B. Removal of Protective Covering (*Pavements*).

After twenty-one (21) days, the contractor may used a mormon or a fresno scraper to remove the earth cover, except that scrapers shall not be used within one (1) foot of expansion joints. Cover within one (1) foot of expansion joints must be removed by hand. Road machines, or blade graders of the two (2) or four (4) wheel type shall not be used for removing the cover from pavements built with expansion joints and in no case shall the covering material be removed until 28 days after placing.

47. WATERPROOFING, DAMPPROOFING, SPECIAL PROTECTIVE TREATMENTS, FACINGS AND HARDENERS.

47A. General Requirements.

(When special materials are specified they shall be placed in accordance with the manufacturers' specifications.)

48. WATERPROOFING (*Membrane*).

(*Note to Architect and Engineer:* Membranous waterproofing is necessary only in exceptional cases and then only as an added safeguard against water penetration. See *Part II—Materials: General Statement, 24A.*

48A. General Requirements.

Waterproofing membranes may consist of cotton drill, felt or burlap of such texture and weight and saturated with asphalt or coal tar pitch in a manner satisfactory to the Architect or Engineer.

In melting and mixing the asphalt or coal tar mastic, by which the membrane is to be secured to the concrete surface, the temperature of the mixture shall not exceed 350 degrees F.

No waterproofing operations shall be carried on when the temperature of the air is below 40 degrees F., or when the surfaces are exposed to wet weather.

Only workmen skilled in the application of membranous waterproofing shall be employed in this work.

Membranous waterproofing shall consist of a continuous sheet (composed of..... distinct layers of membrane and.....applications of the mastic) of waterproofing surrounding the exterior and bottom of the structure to the height indicated on the plans or directed by the Architect or Engineer.

48B. Preparation of Surface.

The entire surface upon which the waterproofing is to be applied shall be comparatively smooth and as dry as is practicable. Special means such as cleaning surfaces with gasoline or drying and warming vertical and inclined surfaces by applying and igniting gasoline or by covering horizontal surfaces with hot sand, shall be employed wherever so directed by the Architect or Engineer.

48C. Application of Priming Coat.

After satisfactory preparation of the surface a light prime coat or paint of asphaltum or coal tar shall be thoroughly brushed into the pores of the concrete.

48D. Application of Waterproofing Mastic.

When the prime coat has dried sufficiently, the entire surfaces on which waterproofing is to be applied shall be mopped with the hot coal tar or asphalt mastic to a uniform thickness of not less than 1/16 inch. Care must be taken that each layer of mastic thus spread is free from cracks or blowholes. Each layer of mastic must cover the entire surface receiving waterproofing treatment.

48E. Application of Waterproofing Membrane.

While the mastic layer, applied as above, is still hot, a layer of the saturated waterproofing membrane shall be applied to the surface. The membrane must be rolled out onto the mastic and pressed into it so as to insure its being completely stuck over its entire surface.

Alternate layers of mastic and membrane shall be applied until the specified number of each has been placed. Great care must be taken to lap all vertical joints of the membrane sheets at least 10 inches. The membrane sheets shall be laid horizontally, shingle fashion, lapping the lower layer ..... the width of the next sheet beneath.

(*Note to Architect or Engineer:* Three to five layers of membrane are recommended. If three are used, lap sheets 1/3, if five then lap 1/5. One more coating of mastic is required than the number of sheets of membrane used.)

48F. Membrane Protection.

Where waterproofing is applied to exterior of inclined or perpendicular walls, it must be permanently protected by a layer of concrete at least 3 inches thick.

On horizontal surfaces, the membrane shall be protected immediately after placing by a 1-inch cement mortar coat but no traffic shall be allowed on the floor area until the floor proper has been placed and cured. Care must be used to prevent injury to the waterproofing before and during placing of the protective covering. Any defects or injury shall be promptly repaired to the satisfaction of the Architect or Engineer.

48G. Integral.

Integral compounds shall not be used unless specifically authorized by the Architect or Engineer

49. DAMPPROOFING (*Walls*).

The method of applying the superficial dampproofing shall be as follows:

(To be supplied by the Architect or Engineer.)

50. SPECIAL PROTECTIVE TREATMENTS.

50A. Oilproofing (*Fuel oil lighter than 35 degrees Baume*).

All surfaces which are to be in contact with the oil shall be coated immediately after construction, with a spar-varnish or other coating not affected or penetrated by mineral spirits.

Coatings containing gums, oils, or other ingredients saponifiable in the presence of lime shall be applied only after the surfaces have been previously treated with a chemical reagent to neutralize the lime.

The treatment to be applied and method of application shall first be approved by the Architect or Engineer.

(*Note to Architect or Engineer:* Concrete structures for purposes of containing mineral oils heavier than 35 degrees Baume require no coating. All treatment of the structure should be applied at the time of construction.)

Certain vegetable and animal oils and strong acids and alkaline solutions have a destructive effect on concrete and some protective treatment is required. Several vegetable oils have a disintegrating effect on concrete in cases where the surface is alternately wet and dry, yet when stored in closed concrete containers have no injurious action.

The use of concrete in contact with many liquids having commercial application involves certain special features in addition to the general requirements of good concrete. Concrete structures intended to contain such liquids often involve thin sections and a rich mixture is necessary in order to obtain concrete of proper workability without sacrificing strength and impermeability. It is especially necessary to eliminate joints or seams. Thorough spading of the concrete in walls is essential and should be continuous during the placing of concrete.

(See *Appendix II* for "Effect of Oils and Miscellaneous Liquids on Concrete and Method of Protective Treatment Where Required.")

51. CONCRETE DRAIN TILE (*Laying of*).

51A. General Requirements.

(*Note to Engineer:* Concrete drain tile shall be made in accordance with the specifications elsewhere herein given, covering selection of materials, methods of making, placing and curing concrete, with special reference to concrete products. The tile shall conform in all respects to the "Standard Specifications for Drain Tile," of the American Society for Testing Materials, Serial No. C 4-21.)

51B. Excavation.

Trenches may be excavated either by hand or machine. Digging shall begin at the outlet and proceed up-grade. Care must be exercised not to dig below the required grade. The bottom of the trench should be finished to the required depth and brought to a uniform gradient with a drain scoop or other suitable tool, and formed to the curvature of the lower third of the tile circumference.

51C. Inspection, Visual (*At the trench*).

All tile shall be given a thorough visual inspection at the trench by a competent inspector employed by the Engineer. The inspector shall cull out and reject all imperfect tile. The tile shall be uniform in structure throughout and shall give a clear ring when stood on end and tapped with a light hammer. Tile shall be smooth on the inside and shall be free from cracks and checks extending into the body of the tile in such a manner as to decrease the strength. The ends of the tile shall not be chipped, cracked or broken so as to decrease the strength or admit earth into the drain. The tile shall not vary in physical properties more than the specified allowable amount indicated for each class of tile in the "Standard Specifications for Drain Tile" mentioned under *General Requirements*. The inspector shall plainly mark all tile which are acceptable for use. The rejected tile shall be removed to a distance from the trench and piled until their removal from the site.

51D. Laying the Tile.

The tile shall be carefully lowered into the trench to prevent injury to the surface and ends and in such a manner as to avoid unnecessary handling in the trench. The tile shall be laid end to end so that the joints will be nearly closed. Each tile shall be laid true to line and grade so as to form a smooth continuous channel.

51E. Blinding and Backfilling.

As rapidly as the tile are laid, they shall be blinded with a covering of soil about 1 foot deep. Wherever the soil encountered is such that, in the opinion of the inspector, it may filter into the drain through the joints, the joints shall be covered with pieces of burlap before the soil covering is placed.

The trench may be filled by hand, team and scraper or other means designed for this purpose. All excavated material shall be placed back in the trench and in a pile immediately above it. After heavy rains the completed line should be carefully inspected and refilled wherever any considerable settlement or wash has occurred.

52. CONCRETE SEWER PIPE (*Laying of*).

52A. General Requirements.

(*Note to Engineer:* Concrete pipe shall be made in accordance with the specifications elsewhere herein given, covering selection of materials, methods of making, placing and curing concrete. The pipe shall in all respects conform to the "Standard Specifications for Cement-Concrete Sewer Pipe" of the American Society for Testing Materials, Serial No. C 14-20.

52B. Excavation (*General*).

Unless otherwise specified, excavation shall be in open cut. In special cases where tunneling is contemplated, permission for such work must first be had of the Engineer and the methods to be employed shall be subject to his approval.

Trenches shall be only of sufficient width to provide a free working space on each side of the pipe, preferably not over ⅓ the nominal pipe diameter and in no case less than 4 inches. In all cases there shall be sufficient space between the pipe and the sides of the trench to make it possible to thoroughly compact the backfilling around the pipe and to permit access to the full circumference at the bell for proper jointing.

52C. Preparation of Trenches.

The bottom of the trench shall be so formed as to prevent any subsequent settlement of the pipe.

(a) *Trench Bottom in Rock.* Where the trench bottom is rock, additional excavation must be made to a uniform depth of at least 4 inches below the outside of the bottom of the pipe and the pipe bell. This depth shall then be refilled with an equalizing bed of concrete, sand or other suitable material approved by the Engineer. The filling material must be carefully placed and thoroughly compacted and must be brought to the correct grade, so molded or pared as to afford a uniform and continuous bearing for the lower third section of the pipe over its entire length.

(b) *Trench Bottom in Firm Earth.* Where the trench is in good, firm earth, the bottom shall be pared or molded so as to give a full support to the lower third section of each pipe. If deemed necessary by the Engineer and wherever so directed by him, proper bearing for the pipe must be provided by placing a layer of concrete, fine gravel or other suitable material in the trench bottom. Wherever the excavation has been made deeper than necessary the trench shall be rebottomed in a manner as specified for trenches in rock.

(c) *Trench with Poor Bottom.* Where the trench bottom has no good natural foundation, the pipe shall be laid in a cradle, constructed and supported as indicated on the detail drawing.

(*Note to Engineer:* Where trench is through wet soil and damage is likely to occur from infiltration of ground water under pressure or by undermining the line by flowing along the pipe, suitable underdrainage should be provided for by a system of sub-drains.)

52D. Removal of Water.

The trenches and pipe line must be kept free from water until the jointing material and other fresh cement-concrete work has sufficiently hardened to prevent injury from flowing water.

52E. Inspection, Visual (*At the trench*).

(*Note to Engineer:* See Paragraph 51C.)

52F. Laying Pipe.

The laying of the pipe in the finished trench shall commence at the lowest point and proceed upgrade. All sockets must be carefully cleaned before lowering pipes into the trench. The pipe should be lowered in such a manner as to avoid unnecessary handling in the trench. Units shall be placed so that spigot ends point in the direction of flow. All pipe shall be laid with ends abutting and true to line and grade. The units shall be fitted and matched so that when laid in the work they will form a sewer with a smooth and uniform invert. Care must be used in shoving the pipe home, so as to secure tight joints. The pipe shall be set firmly to line and grade and the joints carefully filled and finished with the jointing material.

52G. Jointing.

Joints shall be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than ¾ inch, and in one piece of sufficient length to pass around the pipe and lap at the top, shall be solidly rammed into the annular space between the pipe, using a suitable caulking tool. The gasket shall first be saturated with neat cement grout. The remainder of the joint space, left after caulking the gasket, shall be solidly filled with portland cement mortar (proportion 1:2) and neatly troweled and finished to a 45-degree bevel beyond the edge of the bell, forming a continuous ring around the pipe.

52H. Backfilling.

No backfilling shall be placed until at least.....hours after jointing material has been placed and the completed section inspected and approved by the Engineer or his inspector. The pipe shall then be carefully blinded with selected material from the spoil pile or as otherwise directed by the Engineer or his inspector. Clean earth, sand or rock dust may be used and shall be solidly tamped in layers about the pipe up to a level at least 2 feet above the top of the pipe. The filling of the trench must be carried on simultaneously on both sides of the pipe in such a manner as to avoid injurious side pressures.

Puddling of the fill will not be permitted except where the material is largely sand or gravel. If this method is used, the first flooding shall not be applied until after the backfilling has been compacted by tamping up to 2 feet above the top of the pipe, and the succeeding floodings, during or after the subsequent filling of the trench. An excess of water should be avoided in order to prevent disturbance of the earth under and around the pipe and also to prevent an undue excess of pressure upon it.

52I. Protection after Laying.

Walking or working on the completed sewer except as may be necessary in tamping or backfilling, will not be permitted until the trench has been backfilled to a height of at least 2 feet above the top of the pipe.

53. CONCRETE ROOFING TILE (*Placing of*).

53A. General Requirements.

The contractor shall furnish all labor, materials, tools and equipment needed to entirely complete the concrete tile roofing, including all valleys, ridges and flashing as specified and shown on the drawings. No cracked or broken tile or tile with broken corners or warped tile will be permitted to be placed on the roof. All materials entering into the work and all methods used in laying the tile shall be subject to the approval of the Architect or Engineer.

53B. Small Tile (*Definition of*).

Small tile shall be understood to be tile supported directly on roofing paper and roof sheathing.

53C. Large Tile (*Definition of*).

Large tile shall be understood to be tile spanning between purlins and may consist of, (a) interlocking tile for pitched roofs, and (b) flat tile, for roofs having a slope less than $^1/_6$ pitch.

53D. Laying (*Small tile*).

Over the sheathing shall be applied an approved felt roofing paper, weighing not less than 12 pounds per 100 square feet, laid parallel to the eaves. All hips shall be capped longitudinally with an extra ply of felt at least 12 inches wide. In the valleys an extra ply of felt shall be laid longitudinally, full sheet wide. Where felt extends against vertical walls, it must be carried at least 6 inches on the vertical surface, under counter flashing. The roof shall be watertight when applying of the felt is completed.

Over the felting nail $^3/_{16}$-inch thick wood strips or lath on 18-inch centers, from eaves to ridge. Nailing strips $^3/_4$ inch by $1^3/_4$ inches shall be nailed on the lath, parallel with the eaves. Upon these strips the tile courses shall be securely fastened.

The roof shall be accurately laid out with rule and chalk line and when the tile are laid the courses shall present a straight and uniform appearance when viewed vertically, horizontally or diagonally. All hip and ridge roll tile shall be of the same composition as the main roof tile and shall be accurately laid and bedded in 1:3 portland cement mortar, colored with approved mineral pigment to match the balance of the roof.

53E. Laying (*Large tile*).

Large interlocking tile (weighing not over 16 pounds per square foot) shall not vary from the specified thickness, indicated on the detail drawings, more than $^1/_{16}$ inch nor be warped more than $^1/_8$ inch.

Large flat tile (weighing not over 17 pounds per square foot) shall not vary in thickness more than $^1/_{16}$ inch nor be warped more than $^1/_8$ inch.

Large interlocking tile shall be self fastening and shall be laid in place by a hanger at the upper end and laid on purlins, spaced as directed by the manufacturer. The tile shall lock sideways by means of the side roll and rabbet, which must be integral parts of the tile. Gable ends shall be finished with end finishing tile with the tile wing flat against the end walls of the building. Where gable end walls extend above the roof, a 4 by 4-inch chase shall be left in the wall at the line of the top of the purlins for reception of the end tile. The roof ridge shall be finished with an interlocking ridge roll of the same material as the main roof tile, properly cemented to the main roof. The spacing between tops of ridge purlins shall not exceed 8 inches. Hips shall be finished with interlocking hip roll of the same material as the main roof tile and laid in portland cement mortar to fit tightly on the main roof. Bearing for interlocking hip roll shall be provided to the height of the purlin tops in order to properly support the roof tile. Wherever so indicated on the drawings flashing plates of the same material as the roofing tile shall be provided. All tile when laid shall be properly pointed with portland cement mortar.

Gutters and roofs of less than $^1/_6$ pitch shall be formed with standard reinforced flat tile to conform with the drawings. The joints of large flat tile shall be pointed with portland cement mortar so as to provide a smooth surface for the application of the composition roofing which is to be applied to the roof surface.

53F. Guarantee (*Maintenance of watertight condition*).

The contractor shall furnish an unqualified guarantee, with good and sufficient bond, covering the maintenance of the roof in a watertight condition for a period of.....years from the date of completion.

54. CONCRETE BUILDING BLOCK AND BUILDING TILE (*Laying of*).

54A. General Requirements.

(*Note to Architect or Engineer:* Concrete block shall be made in accordance with the specifications elsewhere herein given, covering selection of materials, methods of making, placing and curing concrete with special reference to concrete products. The block shall in all respects conform to the test requirements for "Load Bearing Block," as specified in the "Proposed Standard Specifications for Concrete Building Block and Concrete Building Tile" of the American Concrete Institute. These specifications also provide for other grades of block than the "Load Bearing," as above mentioned, which may be used as the particular work under consideration may require.)

54B. Mortar (*Laying concrete block*).

All concrete block shall be laid up on portland cement mortar, proportions 1:3. Lime may be used in the mortar in an amount not to exceed 5 per cent, by weight, of the cement used.

54C. Laying Block.

General. All block shall be thoroughly wetted on the jointing faces before being placed in the wall. Block shall be laid up in a full bed of mortar and both ends of each block must be "buttered" and the block pushed up hard against the adjoining unit.

(a) *Walls.* All walls and basement partitions shall be constructed of concrete block, as indicated on the plans. Special jamb block shall be used for window and door openings as shown on the detail sheet. Floor joists shall be built into the wall 4 inches, with fire cut, as shown. Regular "joist block" having a recess for the end of the joist may be used or a special 4-inch slab block, 16 inches wide and 8 inches high may be laid in the outer face and special 4-inch slab block about 14 inches long shall be placed between the joists on the inner face of the wall as shown on the sheet of construction details. The vertical joint between the inner and outer block shall be left open.

(b) *Chimneys and Fireplaces.* Chimneys and fireplaces shall be constructed as shown on the plans, with all flues of the sizes marked and lined with standard hard burned clay flue linings. The walls around flues shall be not less than 4 inches thick (and thicker where so indicated) and built up of 4-inch solid concrete block. All flues are to be separate and distinct from the bottom to the top. Tile flue lining shall start not less than 3 feet below the lowest thimble in the basement or as indicated on the plans. No joists or other woodwork shall be built into the flues. The chimney top shall be finished with a concrete cap, as shown.

54D. Jointing (*Types of*).

(*Note to Architect or Engineer:* Mortar joints used in laying concrete block may be either flush, struck, convex, concave or raked. The flush joint may be used where stucco is to be applied. The struck joint and concave joint are recommended in face block construction.)

54E. Jointing (*Basements*).

(*Note to Architect or Engineer:* For ordinary well-drained soils, joints must be well filled with portland cement mortar and carefully pointed. Where the subsoil does not have good drainage, the usual method is to apply one or more coats of 1:3 portland cement plaster to the exterior wall surface below grade.)

54F. Fire Stops.

The course of block below the first floor joists shall have a strip of metal lath 6 inches wide laid in it and a ½ inch bed of portland cement mortar laid upon it as a fire stop.

The wall plates of the roof shall cover the full thickness of the wall and shall be bedded in portland cement mortar as a fire stop. The wall plate shall also be anchored with bolts spaced 6 feet apart. Each anchor bolt shall be set in a core of the block and the core filled with concrete.

55. FINAL TESTS.

55A. Required by Local Ordinances.

Tests made on finished work shall conform to the methods and requirements of the local ordinances.

55B. Required by Architect or Engineer.

(To be supplied by the Architect or Engineer.)

55C. Number of Specimens (*Products*).

Specimens for absorption and compression tests shall be representative of the commercial product of the plant. Not less than 3 and preferably 5 specimens shall be required for block or tile and not less than 5 for brick.

The specimens used in the absorption test may be used for the strength test provided they have been dried at approximately 70 degrees F. for not less than 5 days.

55D. Compression Test (*Products*).

This test shall be made as specified for making compression test on concrete, as hereinbefore specified.

The specimen to be tested shall be carefully measured for over-all dimensions of length, width and height. The bearing surfaces shall be made plane by capping with plaster of paris or a mixture of portland cement and plaster, which shall be allowed to thoroughly harden before the test. Specimens shall be accurately centered in the testing machine and the load applied through a spherical bearing block placed on top of the specimen. When testing other than rectangular block or tile, care must be taken to see that the load is applied through the center of gravity of the specimen. Metal plates of sufficient thickness to prevent appreciable bending shall be placed between the spherical bearing block and the specimen. The specimen shall be loaded to failure. The compressive strength in pounds per square inch of gross cross-sectional area is the total applied load in pounds divided by the gross cross-sectional area in square inches.

55E. Strength Requirement (*Concrete block and tile*).

The gross cross-sectional area of a one piece concrete block or tile shall be considered as the product of the length times the width of the unit as laid in the wall. No allowance shall be made for air spaces in hollow units. The gross cross-sectional area of each unit of a two-piece block or tile shall be considered the product of the length of the unit times one half the thickness of the wall for which the two-piece block or tile is intended.

According to the ultimate strength in compression at 28 days after being manufactured or when shipped, concrete block or tile shall be classified as follows:

Name of Classification of Block or Tile.	Compressive Strength, Lb. per Sq. In. of Gross Cross-Sectional Area as Laid in the Wall.	
	Average of 3 or More Units.	Minimum for the Individual Unit.
Heavy load bearing	1200	1000
Load bearing	700	600
Non load bearing	250	200

(*Note:* These specifications were presented at the Annual Meeting of the American Concrete Institute, Chicago, February 25-28, 1924, and there adopted as a tentative standard.)

55F. Strength Requirement (*Concrete brick*).

The average minimum ultimate compressive strength at 28 days shall be at least 1500 lb. per sq. in. of gross cross-sectional area as laid in the wall. The minimum strength for individual specimens shall be at least 1000 lb. per sq. in. of gross cross-sectional area as laid in the wall.

55G. Absorption Test (*Products*)

The specimens shall be dried to constant weight at a temperature from 212 degrees to 250 degrees F. and the weight recorded. After drying, the specimens shall be immersed in clean water at a temperature of approximately 70 degrees F. for a period of 24 hours. They shall then be removed, the surface wiped off and the specimens reweighed. The absorption is the weight of the water absorbed, divided by the weight of the dry specimens and multiplied by 100.

55H. Absorption Test Requirement (*Concrete block and tile*).

Concrete block and tile when exposed to soil or weather in the finished work shall absorb not more than 10 per cent of the dry weight of the unit when made of concrete weighing 140 pounds per cubic foot or more. For block or tile made of concrete weighing less than 140 pounds per cubic foot, the absorption in per cent of weight of unit shall be not more than 10 multiplied by 140 and divided by the unit weight in pounds per cubic foot of the concrete under consideration.

55I. Absorption Test Requirement (*Concrete brick*).

Concrete brick shall absorb not more than 12 per cent of the dry weight of the specimen when made of concrete weighing 140 pounds per cubic foot or more. When made of concrete weighing less than 140 pounds per cubic foot the average absorption in per cent by weight shall be not more than 12 multiplied by 140 and divided by the unit weight in pounds per cubic foot of the concrete under consideration.

55J. Water Test (*Water storage structures*).

Before the Contractor shall remove his equipment from the site, the structure shall be tested by keeping it full of water and shall show no signs of leakage during a period of seven days. In no case, however, shall the full loading be placed on the structure until 28 days have elapsed after completion of the structure.

55K. Miscellaneous Tests

(To be supplied by the Architect or Engineer.)

Appendix I

SUGGESTED SPECIFICATIONS FOR STRENGTH CONCRETE

GENERAL

Purpose.

It shall be the aim and intent of these specifications that concrete of the strengths assumed in design shall be obtained in the various locations in the structure, with the materials and proportions, by the methods and at the slumps hereinafter indicated.

It shall also be the intent to permit the contractor, when he shall so desire and when he shall conform to the specifications hereinafter indicated, to use such materials, proportions, methods and slumps as he may elect, provided the resultant concrete shall be of the desired strengths in the various locations of the structure, as shown by the tests to be made in the manner hereinafter specified.

DESIGN STRENGTH OF CONCRETE

Method No. 1: By Proportions and Slumps.

Concrete shall be mixed in the proportions indicated in the following table, except as hereinafter designated:

Part of Structure	Proportion by Volume			Desired Strength Lb. per Sq. In.
	Cement	Fine Aggregate	Coarse Aggregate	

The grading of aggregates used in above table is as follows:

(*Note:* The above table is based upon a knowledge by the Engineer of the grading of the aggregates available for the work and upon a knowledge of the strengths that will be obtained in concrete made from these aggregates, mixed in the proportions and with the amount of water to produce the slumps as shown in Table IV. of the Progress Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, and also in Bulletin 9 of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Any other approved method of proportioning to produce the desired strength may be used.)

Should the contractor desire to use aggregates that do not conform to the grading of the aggregates used in the above table, he may do so upon submitting properly taken samples to the Engineer for tests, and by using such proportions as may be determined by the Engineer. Such tests shall be made at the expense of the contractor and he shall receive no additional compensation.

When the contractor has conformed to the terms of the contract with regard to the grading of the aggregates furnished and it shall be found necessary or desirable to change the proportions for any reason whatsoever from those shown in the above table, and such change shall be ordered by the Engineer in writing, the compensation therefor shall be adjusted in the following manner:

When such change entails the use of added materials the contractor shall be compensated therefor upon submitting sworn statements and receipted bills for materials.

When such change entails the use of less materials the contractor shall furnish receipted bills for such materials and the saving shall be deducted from his compensation.

The contractor may change the plasticity or slump of the concrete upon notifying the Engineer of his intention to do so, provided he shall maintain constant the same water-cement ratio by volume as is required to produce the desired strengths. Additional compensation shall not be allowed for such changes.

Method No. 2: By Contract.

When the contractor shall elect to furnish concrete of the desired strength he shall submit to the Engineer properly taken samples of all of the materials to be used and shall furnish him with the proportions to be used at the various slumps, in ample time for twenty-eight (28) day tests, to be made by the Engineer, before any concrete is deposited on the work.

The acceptance or rejection of all concrete placed under this form of contract shall be based upon the average compressive strengths in pounds per square inch at 28 days of three (3) to five (5) cylinders made and tested as elsewhere specified.

Tests.

All sampling and testing of aggregates and concrete shall be made at the expense of the owner except as otherwise specified.

Samples of aggregates shall be representative of the grading of the total aggregate as it shall be used in the mixture and each sample shall be as follows:

Fine aggregate, 50 lb. Coarse aggregate, 100 lb.

The sieves and methods of making a sieve analysis shall conform to the "Tentative Method of Test for Sieve Analysis of Aggregates for Concrete," (Serial designation: C41-21T) of the American Society for Testing Materials.

The decantation test shall be made in accordance with the "Standard Method of Test for Quantity of Clay and Silt in Sand for Highway Construction," (Serial designation: D74-21) of the American Society for Testing Materials.

Sand which shows a color darker than the standard color when tested in accordance with the "Tentative Method of Test for Organic Impurities in Sands for Concrete," (Serial designation: C40-21T) of the American Society for Testing Materials, shall not be used, unless the concrete made with the materials and in the proportions specified for the work is shown by tests made by the Engineer, to be of the required strength.

The consistency of the concrete shall be measured by the slump test in the manner described in the "Tentative Specifications for Workability of Concrete for Concrete Pavements," (Serial designation: D62-20T) of the American Society for Testing Materials or by other approved methods.

Six to ten compression test specimens shall be made from the first batches of each type of concrete, one-half of which shall be stored under standard conditions for quality determination and the remainder shall be stored on the job under construction conditions for future testing.

In addition to the foregoing, three to five specimens shall be made from the concrete entering the foundations, each floor, each story of columns and walls and the roof. The Architect or Engineer may require the preparation of more specimens on account of climatic changes or for any other exceptional reason.

Compression test specimens of the mixed concrete shall be made in the field in accordance with the current "Standard Methods of Making and Storing Specimens of Concrete in the Field" of the American Society for Testing Materials. All test specimens shall be stored and delivered as directed by the Architect or Engineer. All test specimens shall be made and tested at the expense of the owner, except as otherwise specified.

MATERIALS

Portland Cement.

Portland cement shall meet the requirements of the current "Standard Specifications and Tests for Portland Cement" adopted by the American Society for Testing Materials. (Serial designation: C9-21.)

Fine Aggregate.

The fine aggregate shall consist of sand, stone screenings or other inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, durable, uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other harmful substances.

Coarse Aggregate.

The coarse aggregate shall consist of crushed stone, gravel, or other approved inert materials with similar characteristics, or combination thereof, having clean, hard, strong, durable, uncoated particles free from injurious amounts of soft, friable, thin elongated or laminated pieces, alkali, organic or other harmful matter.

Water.

The water for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other harmful substances. The water should preferably be potable.

CONSTRUCTION

Proportioning Concrete.

The unit of measure shall be the cubic foot, and ninety-four pounds (one bag or ¼ bbl.) of portland cement shall be considered as one cubic foot.

Each of the constituent materials shall be measured separately by volume. The method of measurement shall be such as to secure the specified proportions in each batch. The fine and coarse aggregates shall be measured loose as thrown into the measuring device. The water shall be measured in such a manner as will insure the specified slump in successive batches.

Hand Mixing.

When hand mixing is authorized by the Engineer it shall be done on a watertight platform. The cement and fine aggregate shall first be mixed dry, being turned until a mixture of uniform color is obtained. The coarse aggregate shall then be added and the whole mass turned at least 3 times to a uniform mixture. The water shall then be added while the entire mixture is again turned at least 3 times, or until a homogeneous mass of the required consistency is obtained.

Machine Mixing.

Mixing, unless otherwise authorized by the Engineer, shall be done in a batch mixer of approved type, which will insure a uniform distribution of the materials throughout the mass, so that the mixture is uniform in color and homogeneous. The mixer shall be equipped with suitable charging hopper, water storage, and a water-measuring device controlled from a case which can be kept locked and so constructed that the water can be discharged only while the mixer is being charged. The entire contents of the drum shall be discharged before recharging. The mixer shall be cleaned at frequent intervals while in use.

Time of Mixing.

The mixing of each batch shall continue not less than 1 minute after all the materials are in the mixer, during which time the mixer shall rotate at a peripheral speed of about 200 ft. per minute. The volume of the mixed material per batch shall not exceed the manufacturer's rated capacity of the mixer.

Retempering.

The retempering of concrete or mortar which has partially hardened, that is, remixing with additional water, shall not be permitted.

Depositing Concrete.

Before beginning a run of concrete, hardened concrete and foreign materials shall be removed from the inner surfaces of mixing and conveying equipment.

Handling.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be deposited in approximately uniform horizontal layers; the piling up of the concrete in the forms in such manner as to permit the escape of the mortar from the coarse aggregate will not be permitted. Forms for walls or other thin sections of considerable height, shall be provided with openings, or other devices that will permit the concrete to be placed in a manner that will avoid accumulations of hardened concrete on forms or metal reinforcement. Under no circumstances shall concrete that has partially hardened be deposited in the work.

Spouting.

When concrete is conveyed by spouting, the plant shall be of such size and design as to insure a practically continuous flow in the spout. The angle of the spout with the horizontal shall be such as to allow the concrete to flow without separation of the ingredients. The spout shall be thoroughly

flushed with water before and after each day's run. The delivery from the spout shall be as close as possible to the point of deposit. When operation must be intermittent, the spout shall discharge into a hopper. The slope of the spout shall not be flatter than 1 vertical to 2½ horizontal.

Compacting.

Concrete, during and immediately after depositing, shall be thoroughly compacted by means of suitable tools. For thin walls or inaccessible portions of the forms where the use of tools is impracticable, the concrete shall be assisted into place by tapping or hammering the forms opposite freshly placed concrete. The concrete shall be thoroughly worked around the reinforcement, and around embedded fixtures, into the corners of the forms.

Removal of Water.

Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Engineer. Any flow of water into the excavation shall be diverted through proper side drains to a sump, or by other approved methods which will avoid washing the freshly deposited concrete.

Protection.

Exposed surfaces of concrete shall be protected from premature drying for a period of at least 7 days after being deposited.

Cold Weather.

Concrete mixed and deposited during freezing weather shall have a temperature of not less than 50 degrees F. nor more than 120 degrees F. Suitable means shall be provided for maintaining a temperature of at least 50 degrees F. for not less than 72 hours after placing, or until the concrete has sufficiently hardened. The methods of heating the materials and protecting the concrete shall be approved by the Engineer. Salt, chemicals or other foreign materials shall not be used for the purpose of preventing freezing unless approved by the Engineer.

Depositing Continuously.

Concrete shall be deposited continuously and as rapidly as practicable and until the unit of operation, as approved by the Engineer, is completed. Construction joints at points not provided for in the plans shall be made only at locations approved by the Engineer.

Bonding.

The surface of the hardened concrete shall be roughened and thoroughly cleaned of foreign matter and laitance, and saturated with water and forms retightened before depositing additional concrete. An excess of mortar on vertical or inclined surfaces shall be secured by thoroughly rodding or spading the freshly deposited concrete to remove the coarse aggregate from contact with the hardened concrete.

Appendix II

SPECIAL RECOMMENDATIONS

For use of the Architect and Engineer, in connection with the main body of specifications under the paragraph number and heading indicated.

PART II—MATERIALS

5B. Grading (*Coarse aggregate*).

(*Note:* The size and grading to be used will be governed by local conditions. The limitation on size and grading is intended to secure uniformity of aggregate. The following table indicates desirable gradings for coarse aggregate for certain maximum sizes.)

TABLE OF DESIRABLE GRADINGS

Maximum Size of Aggregate	Per Cent by Weight Passing Through Standard Sieves with Square Openings						Per Cent Passing Not More Than	
	3 In.	2 In.	1½ In.	1 In.	¾ In.	½ In.	No. 4 Sieve	No. 8 Sieve
3 In.	95		40–75				10	5
2 In.		95		40–75			10	5
1½ In.			95		40–75		10	5
1 In.				95			10	5
¾ In.					95		10	5
½ In.						95	10	5

PART III—CONSTRUCTION

10J. Joints (*Crosswise of structure*).

In structures over 100 feet long, the length being over twice the width, crosswise joints should be placed near the middle and at intervals not exceeding 100 feet. Joints should also be placed where marked changes in plan section occur. The locations, size, shape, etc., of each joint should be plainly indicated on the plans and detail sheets so that the manner of their construction will be clearly indicated.

Special reinforcement should be placed at right angles to the joint and extend a sufficient distance on each side of the joint to develop the strength of the reinforcement by bond. This reinforcement should be placed near the opposite face of the member from the main tension reinforcement. The amount of such reinforcement should be more than one-half of one per cent of the section area of the member cut by the joint.

11A. Plain Joints. Forming (*Plain concrete slabs*).

Joints in plain concrete slabs should be spaced not to exceed 10 feet apart each way. The joints should be complete through the entire slab thickness. This condition may be obtained by a coating of white lead and oil, asphalt paint, petroleum, waterproof building paper or by any other equally effective materials placed over the entire surface of the hardened concrete forming one side of the joint. The location, spacing and manner of construction of the joints should be clearly indicated on the plans.

11B. Plain Joints. Between Floor Slab and Wall (*Plain concrete*).

A joint should be placed between the sidewalls and the abutting floor slabs. This joint should be made wedge shaped in section, having the bottom wider than the top. The wedge shape may be formed by inserting two strips of wood (one rectangular and the other triangular in section) where each joint is to be formed. These strips can be easily removed after the concrete has sufficiently hardened, and the space filled with tar, pitch or other suitable joint filler. The location, size, shape and manner of construction of these joints should be clearly indicated on the plans.

12B. Fluidtight Joints (*Vertical*).

Where it is necessary to construct vertical joints that shall be fluidtight, a recess or "key way" should be provided in one face of the joint surface. When forming this recess, a strip of deformed sheet copper or heavily galvanized iron, at least 10 inches wide, should be inserted so that one-half of the width of the metal strip will protrude beyond the face of the joint to engage the concrete of the abutting section of the wall. The metal dam should be in one continuous piece over the full height to be protected and should extend well into the footing concrete. The joint surface should be heavily coated with asphalt, tar, pitch or other suitable composition joint filler before the adjoining section of the wall is placed. The location, size, shape and manner of construction of the joints should be clearly indicated on the plans.

13D. Joints (*Crosswise of building*).

(See Appendix II: 10 J. *Joints, crosswise of structure.*)

14G. Spacing (*Reinforcement*).

Spacing of all reinforcement should be clearly indicated on the plans.

Parallel bars should not be closer in the clear than 1½ times the diameter of round bars or 1½ times the diagonal of square bars.

In no instance should the spacing between bars be less than 1¼ times the maximum size of the coarse aggregate and never less than 1 inch.

Appendix III

STANDARD AND TENTATIVE SPECIFICATIONS AND TESTS OF THE A. I. A. AND A. S. T. M.

(Those referred to in the foregoing specifications are so indicated.)

PART I—GENERAL

	Referred to on Page	Paragraph
GENERAL CONDITIONS.		
Standard General Conditions of the Contract of the American Institute of Architects	8	1

NOTE: Standard documents of the American Institute of Architects may be obtained direct from the Executive Secretary of the A. I. A., The Octagon House, Washington, D. C.

PART II—MATERIALS

NOTE: The following Specifications and Methods of tests of the A. S. T. M., (American Society for Testing Materials) may be obtained direct from the Secretary of the A. S. T. M., 1315 Spruce Street, Philadelphia, Pa.

PORTLAND CEMENT.		
Standard Specifications and Tests for Portland Cement, (Serial designation: C 9-21) of the A. S. T. M.	8	2A
AGGREGATES.		
Tentative Method of Test for Sieve Analysis of Aggregates for Concrete, (Serial designation: C 41-21 T) of the A. S. T. M.	8	3B
Concrete Aggregates, (Serial designation: C 33-21 T) of the A. S. T. M.		
Test for Apparent Specific Gravity of Sand, Stone and Slag Screenings and other Fine Non-Bituminous Highway Materials, (Serial designation: D 55-19) of the A. S. T. M.		
Tentative Method of Test for Organic Impurities in Sands for Concrete, (Serial designation: C 40-21 T) of the A. S. T. M.	9	4B
Sedimentation Test for Sand and other Fine Aggregates, (Serial designation: D 136-22 T) of the A. S. T. M.	9	4E
Standard Method for quantity of Clay and Silt in Sand for Highway Construction, (Serial designation: D 74-21) of the A. S. T. M.	9	4D
Specifications and Tests for Compression Strength of Portland Cement Mortars, (Serial designation: C 9-21) of the A. S. T. M.	9	4H
Test for Apparent Specific Gravity of Coarse Aggregates, (Serial designation: D 30-18) of the A. S. T. M.		
Test for Toughness of Rock, (Serial designation: D 3-18) of the A.S.T.M.		
Test for Abrasion of Road Material, (Serial designation: D 2-08) of the A. S. T. M.		

	Referred to on Page	Paragraph
HYDRATED LIME.		
Hydrated Lime for Structural purposes, (Serial designation: C 6-22 T) of the A. S. T. M.	11	14A
REINFORCEMENT.		
Standard Specifications for Billet-Steel Concrete Reinforcement Bars, (Serial designation: A 15-14) of the A. S. T. M.	12	22A
	12	22D
	13	22F
Standard Specifications for Rail-Steel Concrete Reinforcement Bars, (Serial designation: A 16-14) of the A. S. T. M.	13	22F
Tentative Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, (Serial designation: A 82-21 T) of the A. S. T. M.	12	22D
	13	22G
Standard Specifications for Structural Steel for Bridges, (Serial designation: A 7-21) of the A. S. T. M.	13	22H
Standard Specifications for Structural Steel for Buildings, (Serial designation: A 9-21) of the A. S. T. M.	13	22H
Standard Specifications for Cast-Iron Pipe and Special Castings, (Serial designation: A 44-04) of the A. S. T. M.	13	22I
PART III—CONSTRUCTION		
CONSISTENCY.		
Tentative Specifications for workability of Concrete for Concrete Pavements, (Serial designation: D 62-20 T) of the A. S. T. M.	34	19E
Test for consistency of Portland Cement Concrete for Pavements or for Pavement Base, (Serial designation: D 138-22 T) of the A. S. T. M.		
TESTING.		
Tentative Methods of Making Compression Tests of Concrete, (Serial designation: C 39-21 T) of the A. S. T. M.		
Standard Methods of Making and Storing Specimens of Concrete in the Field, (Serial designation: C 31-21) of the A. S. T. M.	36	24C
Securing Specimens of Hardened Concrete from the Structure, (Serial designation: C 42-21 T) of the A. S. T. M.		
Standard Specifications for Drain Tile, (Serial designation: C 4-21) of the A. S. T. M.	50	51A
Standard Specifications for Cement-Concrete Sewer Pipe, (Serial designation: C 14-20) of the A. S. T. M.	50	52A
INSPECTION.		
Inspection of Concrete and Reinforced Concrete Work, (Serial designation: C 44-22 T) of the A. S. T. M.		

AVERY CLASSICS

CODED SPECIFICATIONS

WITH INDEX

Appendix IV

CODED SPECIFICATIONS

FOR

PLAIN AND REINFORCED CONCRETE

with Index

Note: See page 3 of the main section of this Specification Manual for suggestions on how to use the Coded Specifications.

Index to

CODED SPECIFICATIONS

Items	Reference	Specification Number	Page
ABUTMENTS	See WALLS, ABUTMENT.		
ALLEYS	See PAVEMENTS, ALLEY.		
AQUEDUCTS	See CANALS; CONDUITS; PIPE; etc.		
BARNYARD PAVEMENTS	See PAVEMENTS, BARNYARD.		
BASEMENTS	See WALLS, BASEMENT.		
BEAMS	See STRUCTURAL MEMBERS.		
BINS, GRAIN		1	69
BINS, COAL		2	69
BLOCK, BUILDING, TAMPED		3	70
BLOCK, BUILDING, WET CAST		4	70
BRICK, TAMPED		5	70
BRIDGES, ARCHED		6	71
BRIDGES, SLAB		7	71
BRIDGES, BEAM AND GIRDER		8	71
BUILDINGS	See STRUCTURAL ITEMS such as FLOORS; FOUNDATIONS; STRUCTURAL MEMBERS; WALLS; etc.		
CANALS, LINING		9	72
CAISSONS	See FOUNDATIONS, CAISSON.		
CELLARS	See WALLS, BASEMENT.		
CONCRETE BLOCK	See BLOCK, BUILDING; etc.		
CESSPOOLS	See MANHOLES.		
CHIMNEYS		10	72
CISTERNS	See MANHOLES; TANKS; etc.		
COLUMNS	See STRUCTURAL MEMBERS.		
CONDUITS, ELECTRICAL		12	73
CONDUITS, SEWER, WATER, etc. (CAST IN PLACE)		11	73
COPINGS	See TRIMSTONE.		
CORNICES	See TRIMSTONE.		
CULVERTS	See BRIDGES; PIPES; etc.		
CURBS, COMBINED WITH GUTTER		13	73
CURBS, INTEGRAL		14	74
CURBS, SEPARATE		15	74
DAMS, GRAVITY		16	74
DAMS, REINFORCED		17	75
DIKES	See WALLS AND DAMS.		
DITCHES, LINING	See CANALS, LINING.		
DOCKS	See PIERS; WHARVES; etc.		
DRAINS	See TILE, DRAIN.		
FENCE POSTS		51	86
FILTRATION TANKS	See TANKS, WATER.		
FLOORS, ONE-COURSE, (NO REINFORCEMENT) LAID ON GROUND		18	75
FLOORS, TWO-COURSE, (NO REINFORCEMENT) LAID ON GROUND		19	75
FLOORS, ONE-COURSE, (REINFORCED) LAID ON GROUND		20	76
FLOORS, TWO-COURSE, (REINFORCED) LAID ON GROUND		21	76
FLOORS, ONE-COURSE, (REINFORCED) ELEVATED		22	77

Items	Reference	Specification Number	Page
FLOORS, TWO-COURSE, (REINFORCED) ELEVATED		23	77
FLUES	See CHIMNEYS.		
FLUMES	See CANALS; PIPES; etc.		
FLUSH TANKS	See TANKS, WATER and MANHOLES.		
FOUNDATIONS, CAISSON, (NON-REINFORCED)		24	77
FOUNDATIONS, CAISSON, (REINFORCED)		25	78
FOUNDATIONS, HEAVY, (NON-REINFORCED)		26	78
FOUNDATIONS, HEAVY, (REINFORCED)		27	78
FOUNDATIONS, SMALL, LIGHT LOADS, (NON-REINFORCED)		28	79
GALLERIES, PIPE	See TUNNELS.		
GARAGES	See BRICKS; BLOCKS; FLOORS; etc.		
GASOLINE STORAGE	See TANKS, OIL.		
GIRDERS	See STRUCTURAL MEMBERS.		
GRAIN, STORAGE	See BINS, GRAIN.		
GREASE-TRAPS	See MANHOLES.		
GUTTERS	See CURBS.		
HIGHWAYS	See PAVEMENTS.		
HOUSES	See BLOCK, BUILDING.		
HOUSE TANKS	See TANKS, WATER; OIL; etc.		
IRRIGATION	See CANALS; PIPE; etc.		
LEVEES	See CANALS, LINING.		
LINTELS	See TRIMSTONE.		
LOCKS, CANAL	See WALLS.		
MANHOLES, SEWERS		29-30	79
MILL BUILDINGS	See STRUCTURAL ITEMS such as STRUCTURAL MEMBERS; FOUNDATIONS; FLOORS; etc.		
MINE TIMERS, (CAST IN PLACE)		31	80
MINE TIMBERS, (PRECAST)		32	80
OIL STORAGE	See RESERVOIRS, OIL and TANKS.		
ORNAMENTAL PRODUCTS, WET CAST		33	80
ORNAMENTAL PRODUCTS, TAMPED		34	80
PARTITIONS	See WALLS.		
PARTY WALLS	See WALLS.		
PAVEMENTS, HIGHWAY, (ONE-COURSE)		35	81
PAVEMENTS, STREET, (ONE-COURSE)		36	81
PAVEMENTS, STREET, (TWO-COURSE)		37	81
PAVEMENTS, STREET, INTEGRAL CURB, (ONE-COURSE)		38	82
PAVEMENTS, STREET, INTEGRAL CURB, (TWO-COURSE)		39	82
PAVEMENTS, ALLEY, (ONE-COURSE)		40	82
PAVEMENTS, BARNYARD, (ONE-COURSE)		41	82
PAVEMENTS, BARNYARD, (TWO-COURSE)		42	83
PIERS AND WHARVES		43	83
PILES, CAST IN PLACE		44	84
PILES, PRECAST		45	84
PIPE, SEWER		46	85
PIPE, WATER		47	85
PITS	See WALLS, PIT.		
PLATFORMS	See FLOORS.		
POLES, ELECTRIC TRANSMISSION (PRECAST)		48	85
POLES, ELECTRIC TRANSMISSION TOWERS (CAST IN PLACE)		49	86
POLES, ELECTRIC LIGHTING		50	86
POOLS, SWIMMING		57	89
POSTS, FENCE		51	86
REFRIGERATION	See TANKS, BRINE.		
RESERVOIRS, OIL		52	87
RESERVOIRS, WATER		53	87
RETAINING WALLS	See WALLS, RETAINING.		

Items	Reference	Specification Number	Page
ROADS	See PAVEMENTS.		
ROOFS	See TILE, ROOFING.		
SEPTIC TANKS	See TANKS, SEPTIC.		
SEWERS	See PIPE, SEWER.		
SIDEWALKS	See WALKS.		
SILLS	See TRIMSTONE.		
SLABS	See FLOORS; PAVEMENTS; WALKS; etc.		
STANDPIPES	See TANKS, WATER.		
STAIRS		54	87
STEPS	See STAIRS.		
STONE, CONCRETE	See TRIMSTONE.		
STREETS	See PAVEMENTS.		
STRUCTURAL MEMBERS		82	97
STUCCO, PORTLAND CEMENT		55	88
SUBWAYS		56	88
SWIMMING POOLS		57	89
TANKS, BRINE		58	89
TANKS, FUEL OIL		59	89
TANKS, SEPTIC		60	90
TANKS, SPECIAL		61	90
TANKS, WATER		62	90
TENNIS COURTS		63	91
TERRAZZO FLOORS	See FLOORS.		
TILE, BUILDING		64	91
TILE, DRAIN		65	91
TILE, ROOFING (LARGE)		83	97
TILE, ROOFING (SMALL)		84	98
TRESTLES	See STRUCTURAL ITEMS such as STRUCTURAL MEMBERS; PILES; PIERS; etc.		
TRIMSTONE		66	92
TUNNELS		67	92
UNDER DRAINS	See TILE, DRAIN.		
VATS	See TANKS.		
VAULTS, BANK		68	92
VAULTS, BURIAL		69	93
VIADUCTS	See BRIDGES.		
WALKS, ONE-COURSE		70	93
WALKS, TWO-COURSE		71	94
WALLS, ABUTMENT		72	94
WALLS, BASEMENT, RESISTING WATER PRESSURE		73	94
WALLS, BASEMENT, ORDINARY		74	95
WALLS, CURTAIN		75	95
WALLS, FIRE		76	95
WALLS, PARAPET		77	96
WALLS, PIT		78	96
WALLS, RETAINING, LARGE, GRAVITY		79	96
WALLS, RETAINING, SMALL, GRAVITY		80	96
WALLS, RETAINING, REINFORCED		81	97
WAREHOUSES	See STRUCTURAL ITEMS such as STRUCTURAL MEMBERS; FOUNDATIONS; FLOORS; etc.		
WATERTANKS	See TANKS, WATER.		
WATERTOWERS	See TANKS, WATER.		
WINDMILLS	See STRUCTURAL ITEMS such as STRUCTURAL MEMBERS; FOUNDATIONS; FLOORS; etc.		
WINDOW SILLS	See TRIMSTONE.		

CODED SPECIFICATIONS

An asterisk (*) placed before a paragraph number means that all of the material in that particular paragraph must be omitted except that which pertains to the particular type of work being considered.

A plus sign (+) placed before a paragraph number means that wording must be supplied by the architect or engineer either in whole or in part, pertaining to the particular type of work under consideration.

No. 1. BINS, GRAIN.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 9, 9A, 9B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, *22H, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, *29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 4, 4A, 4B, 5, +5A, 5B, 5D, 6, 6A, 6B, 6C, 6D, 6E, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 10, 10A, 10J, 11, 11B, 12, 12A, 12B, 13, 13A, 13B, 13C, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14K, 14L, 15, 15A, 15B, 15C, 15D, 15E, 15F, 16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24B, 24C, 25, 25A, 25B, 26, 26A, 26B, 26C, 26D, 26G, 26H, 26M, 26N, 27, 27A, 27B, 27C, 28, 28A, 28B, 28C, 28D, 28E, (*Use only when necessary:* 29, 29A, 29B, 29C, 29D, 29E), 30, 30A, 30B, 30C, 30D, 31, 31A, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 44C, 45, 45A, 45E, 45F, +45L, 45M, 46, 46A, *47, +47A, (*Use if necessary:* 48, +48A, 48B, 48C, 48D, 48E, 48F), 48G, +49, 55, 55A, +55B, +55K.

No. 2. BINS, COAL.

I. GENERAL

+1, +2.

II. MATERIALS

Same as BINS, GRAIN, except *omit:* +25B, +25C.

III. CONSTRUCTION

Same as BINS, GRAIN, except *insert:* 11A; and *omit:* 15D.

No. 3. BLOCK, BUILDING, TAMPED (*Manufacture and Laying of*).

I. GENERAL

+1, +2.

(*Note to Architect or Engineer:* These specifications are intended to cover general practices for the manufacture of concrete block or tile that will meet the current requirements for strength and density tests of the Standard Specifications of the American Concrete Institute.)

II. MATERIALS

Manufacture of Block

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 6, 6A, 6B, 6C, 7, 7A, 7B, 7C, 7D, 12, +12A, 13, 13A, 15, 15A, *24, 24A, 24B, 25, 25A.

III. CONSTRUCTION

(a) Manufacture of Block

1, 6, 6A, 6B, 6C, 6D, 6F, 7, 7D, 7E, 7I, 18, +18A, 19, *19A, *19B, 19C, 19D, 19H, 19I, 19J, 20, 20A, 20C, 20D, 20E, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 25, 25A, 37, 37B, 37D, 41, 45, 45A, 45B, 45C, 45D, 45E, 45G, 45H, 45I, 55, 55A, +55B, 55C, 55D, *55E, 55G, 55H, +55K. (*Where tests of completed units are impossible, use:* 24, 24A, 24C.)

(b) Laying of Building Block and Building Tile

54, 54A, 54B, 54C, 54D, 54E, 54F.

No. 4. BLOCK, BUILDING, WET CAST.

I. GENERAL

Same as BLOCK, BUILDING, TAMPED.

II. MATERIALS

Same as BLOCK, BUILDING, TAMPED.

III. CONSTRUCTION

(a) Manufacture of Block

Same as BLOCK, BUILDING, TAMPED.

(b) Laying of Block

Same as BLOCK, BUILDING, TAMPED.

No. 5. BRICK, TAMPED.

I. GENERAL

Same as BLOCK, BUILDING, TAMPED.

II. MATERIALS

Same as BLOCK, BUILDING, TAMPED.

III. CONSTRUCTION

(a) Manufacture of Brick

Same as BLOCK, BUILDING, TAMPED, except *use* 55F *instead of* 55E; *use* 55I *instead of* 55H.

(b) Laying of Brick

(To be supplied by Architect or Engineer.)

No. 6. BRIDGES, ARCHED.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 9, 9A, 9B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, +22E, *22F, 22G, +22H, 22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 5, +5A, 5C, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 10, 10A, 10J, 13, 13A, 13B, 13C, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14K, 14L, 15, 15A, 15E, 15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, 25B, 26, 26A, 26B, 26C, 26E, 26M, 26N, 27, 27A, 27B, 27C, 28, 28A, 28B, 28C, 28D, 28E, 29, 29A, 29B, 29C, 29D, 29E, 30, 30A, 30B, 31, 31A, 38, *38A, (38B, 38C, 38D, 38E, 38F, 38G), 39, 39A, 39B, 39C, 39D, 39E, 39F, 39G, 39H, 39I, +40, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, *44A, 45, 45A, 45E, 45F, 45J, 45K, +45L, 46, 46A, *47, +47A, 48, +48A, 48B, 48C, 48D, 48E, 48F, 48G, +49, 55, 55A, +55B, +55K.

No. 7. BRIDGES, SLAB.

I. GENERAL

Same as BRIDGES, ARCHED.

II. MATERIALS

Same as BRIDGES, ARCHED.

III. CONSTRUCTION

Same as BRIDGES, ARCHED, except *insert:* 26G, 26K, 33, 33E, 33F, 33G, 33H; and *omit:* 5C, 26E.

No. 8. BRIDGES, BEAM AND GIRDER.

I. GENERAL

Same as BRIDGES, ARCHED.

II. MATERIALS

Same as BRIDGES, ARCHED.

III. CONSTRUCTION

Same as BRIDGES, ARCHED, except *insert:* 26G, 26K, 33, 33E, 33F, 33G, 33H; and *omit:* 5C, 26E.

No. 9. CANALS, LINING (*Irrigation, Etc.*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, *29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 3, 3A, 3B, 4, 4A, 4B, 4F, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6E, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8B, 8C, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13H, 14, 14A, 14B, 14C, 14D, 14E, +14G, 14H, 14I, 14J, 14L, 15, *15A, 15E, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, +25B, 26, 26A, 26B, 26C, 26F, 26G, 26I, 26K, 26M, 27, 27A, 27B, 27C, 30, 30A, 30B, 33, 33E, 33F, 40, 40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, *44A, *44B, 45, 45A, 45E, 45F, +45L, 46, 46A, 46B, *47, +47A, 55, +55B, +55K.

No. 10. CHIMNEYS (*Reinforced Concrete*).

I. GENERAL

+1, +2.

II. MATERIALS

1 to 5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 13, 13A, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15B, 15C, 15E, 15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, *24B, 24C, 25, 25A, 26, 26A, 26B, 26C, 26M, 27, 27A, 27B, 27C, 29, 29A, 29B, 29C, 29D, 29E, 30, 30A, 30B, 30D, 38, *38A, (38B, 38C, 38D, 38E, 38F, 38G), +40, 41, 42, 42A, 42D, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, 48G, +49, 55, 55A, +55B, +55K.

No. 11. CONDUIT, SEWER, WATER, ETC. (*Cast in Place*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 3, 3A, 3B, 3C, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 7J, 8, 8A, 8G, 13, 13A, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15E, 15F, 16, *17, 18, +18A, 19, *19A, *19B, 19C, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 30, 30A, 30B, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, +45L, *47, +47A, (*Use* 48 *to* 48F *incl. if membrane is used*), 48G, +50, 55, 55A, +55B, +55K.

No. 12. CONDUIT, ELECTRICAL (*Precast*).

I. GENERAL

+1, +2

II. MATERIALS

Same as PIPE, SEWER, except *omit:* 22, 22A, 22D, 22E, *22F, 22G, 22J.

III. CONSTRUCTION

(a) Manufacture of Conduit Units

Same as PIPE, SEWER, except *omit:* 14, 14A, +14G, 14H, 14J.

(b) Laying of Conduit

(To be supplied by Architect or Engineer.)

No. 13. CURBS, ROADWAY (*Combined with Gutter*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 23, 23A, 23B, *23C, *24, 24A, 24B.

III. CONSTRUCTION

1, 2, 2A, 3, 3A, 3D, 4, 4A, 4B, +4E, 4H, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 10, *10A, *10B, *10E, *10H, 11, 11A, 11C, +11D, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, 26, 26A, *26B, 26C, 27, 27A, *27B, 30, 30A, 30B, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, *44A, 44B, 45, 45A, 45E, 45K, 45N, 46, 46A, 55, 55A, +55B, +55K.

No. 14. CURBS, ROADWAY (*Integral*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as CURBS, COMBINED WITH GUTTER.

III. CONSTRUCTION

Same as CURBS, COMBINED WITH GUTTER, except *insert:* 10D, 33H, and *omit:* 11, 11C.

No. 15. CURBS, ROADWAY (*Separate*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as CURBS, COMBINED WITH GUTTER.

III. CONSTRUCTION

Same as CURBS, COMBINED WITH GUTTER.

No. 16. DAMS, GRAVITY.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 8, 8A, 8B, 9, 9A, 9B, 10, 10A, 10B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 23, 23A, *24, 24A.

Note: Where reinforcement is necessary, insert the following in their proper location: 22, 22A, 22B, 22D, 22E, *22F, 22G, 22H, +22J.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, +2E, 3, 3A, 3B, 5, 5B, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 12, 12A, 12B, 13, 13A, 13H, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, 25B, 26, 26A, 26B, 26C, 26D, 26N, 26O, 27, 27A, 27B, 27C, 28, 28A, 28B, 28C, 28D, 28E, 30, 30A, 30B, 38, +38A, (38B, 38C, 38D, 38E, 38F, 38G), 41, 42, 42A, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, +45L, 55, +55B, +55K.

Note: Where reinforcement is necessary, insert the following in their proper location: 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15E, 15F.

No. 17. DAMS, REINFORCED.

I. GENERAL

+1, +2.

II. MATERIALS

Same as DAMS, GRAVITY, except *insert:* 22, 22A, 22B, 22D, 22E, *22F, 22G, 22H, +22J.

III. CONSTRUCTION

Same as DAMS, GRAVITY, except *insert:* 13B, 13C, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15E, 15F, 26M.

No. 18. FLOORS, PLAIN CONCRETE, ONE-COURSE. (*No Reinforcement.*) Laid on Ground.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 18C, 19, +19A, +19B, 20, 20A, +20B, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4F, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8B, 8C, 11, 11A, 11B, 11C, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, 25B, 26, 26A, *26B, 26C, 26F, *26K, 27, 27A, 27B, 30, 30A, 33, *33E, 33G, 40, *40A, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45J, 46, 46A, *47, +47A, (*Use the following if necessary:* 48 to 48F incl.), 48G, 55, +55B, +55K.

No. 19. FLOORS, PLAIN CONCRETE, TWO-COURSE. (*No Reinforcement.*) Laid on Ground.

I. GENERAL

Same as FLOORS, PLAIN CONCRETE, ONE-COURSE (*No Reinforcement*).

II. MATERIALS

Same as FLOORS, PLAIN CONCRETE, ONE-COURSE (*No Reinforcement*), except *insert:* 12, +12A, +12B, 15, 15A, +15B.

III. CONSTRUCTION

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4F, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8B, 8C, 11, 11A, 11B, 11C, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 20C, 20D, 20E, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, 26, 26A, *26B, 26C, 26H, *26K, 27, 27A, 27B, 30, 30A, 30D, 32, 32A, 32B, 32C, 32D, 33, (33A *or* 33B), *33G, 40, *40A, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45J, 46, 46A, *47, +47A, (*Use the following if necessary:* 48 to 48F incl.), 48G, +50, 55, +55B, +55K.

No. 20. FLOORS, REINFORCED CONCRETE, ONE-COURSE (*Laid on Ground*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 5C, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 18C, 19, +19A, +19B, 20, 20A, +20B, 22, 22A, 22B, 22C, *22D, 22E, *22F, 22G, 22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4F, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8B, 8C, 10, 10A, 11, 11B, 13, 13A, 13C, 14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14I, 14J, 14L, 15, *15B, 15E, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, 25B, 26, 26A, *26B, 26C, +26G, 26I, *26K, 27, 27A, 27B, 30, 30A, 30B, 33, *33E, *33G, 40, *40A, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45J, 46, 46A, *47, +47A, (*Use the following if necessary:* 48 to 48F incl.), 48G, +49, +50, 55, +55B, +55K.

No. 21. FLOORS, REINFORCED CONCRETE, TWO-COURSE (*Laid on Ground*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as FLOORS, REINFORCED CONCRETE, ONE-COURSE (Laid on Ground), except *insert:* 12, +12A, +12B, 15, 15A, +15B.

III. CONSTRUCTION

Same as FLOORS, REINFORCED CONCRETE, ONE-COURSE (Laid on Ground), except *insert:* 20C, 20D, 20E, 21D, 21H, 26J, 30D, 32, 32A, 32B, 32C, 32D, 33, 33A or 33B; and *omit:* 26I.

No. 22. FLOORS, REINFORCED CONCRETE, ONE-COURSE (*Elevated*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 18C, 19, +19A, 20, 20A, +20B, 21, 21A, +21B, 21C, 21D, +21E, +21F, +21G, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

1, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, +8A, 8G, 9, 9A, +9B, +9C, +9D, +9E, 13, 13C, 14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14I, 14J, 14L, 15, *15B, *15C, 15F, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, *26B, 26C, 26G, *26K, 27, 27A, 27B, 30, 30A, 30B, 33, *33E, 40, *40A, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45J, 46, 46A, *47, +47A, 55, 55A, +55B, +55K.

No. 23. FLOORS, REINFORCED CONCRETE, TWO-COURSE (*Elevated*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as FLOORS, REINFORCED CONCRETE, ONE-COURSE (Elevated), except *insert:* 12, +12A, +12B, 15, 15A, +15B.

III. CONSTRUCTION

Same as FLOORS, REINFORCED CONCRETE, ONE-COURSE (Elevated), except *insert:* 20C, 20D, 20E, 21D, 21H, 26J, 30D, 32, 32A, 32B, (32C *or* 32D), 33, (33A *or* 33B), and *omit:* 26I.

No. 24. FOUNDATIONS, CAISSON (*No Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 9, 9A, 9B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 25, 25A.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, *2E, 3, 3A, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 13, 13A, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26N, 27, 27A, 27B, 27C, 43, 43A, 43C, 43D, 43E, 55, 55A, +55B, +55K.

No. 25. FOUNDATIONS, CAISSON (*With Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as FOUNDATIONS, CAISSON (No Reinforcement), except *insert:* 22, 22A, 22B, 22C, 22E, *22F, 22J.

III. CONSTRUCTION

Same as FOUNDATIONS, CAISSON (No Reinforcement), except *insert:* 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15E, 15F, 26M, and *omit:* 26N.

No. 26. FOUNDATIONS, HEAVY (*No Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 9, 9A, 9B, 10, 10A, 10B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

Same as FOUNDATIONS, CAISSON (No Reinforcement), except *insert:* 3B, 3C, 10, 10J, 12, 12A, 12B, 13D, 30, 30A, 30B.

No. 27. FOUNDATIONS, HEAVY (*With Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as FOUNDATIONS, HEAVY, (No Reinforcement), except *insert:* 22, 22A, 22B, 22C, 22E, *22F, 22J.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6E, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15B, 15C, 15D, 15E, 15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 28, 28A, 28B, 28C, 28D, 28E (*Use* 29 to 29E, incl. *when necessary*), 30, 30A, 30B, 31, 31A, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, (*Use* 48 to 48F, incl. *when necessary*), 48G, +49, 55, 55A, +55B, +55K.

No. 28. FOUNDATIONS, SMALL, WITH LIGHT LOADS (*No Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 9, 9A, 9B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, 2E, 3, 3A, 3B, 3C, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8A, 8F, 8G, 12, 12A, 12B, 13, 13A, 13D, 13H, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, *27B, 27C, 28, 28A, 28B, 28C, 28D, 28E, (*Use* 29 to 29E incl. *if necessary*), 30, 30A, 30B, 31, 31A, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, *47, +47A, (*Use* 48 to 48F, incl. *if necessary*), 48G, +49, 55, 55A, +55B, +55K.

No. 29. MANHOLES, SEWERS, ETC. (*No Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, 2C, 2D, 2E, 3, 3A, 3B, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8A, 8G, 12, 12A, 13, 13A, 13H, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22 23, 24, 24A, 24C, 25, 25A, 26, 26A, 26B, 26C, *26M, 27, 27A, *27B, 27C, 30, 30A, 30B, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 44, +44C, 47, +47A, 48G, +49, 55, 55A, +55B, +55K.

No. 30. MANHOLES, SEWERS, ETC. (*With Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as MANHOLES, SEWERS, etc. (No Reinforcement), except *insert:* 22, 22A, 22B, 22C, 22D, 22E, *22F, +22J.

III. CONSTRUCTION

Same as MANHOLES, SEWERS, etc. (No Reinforcement), except *insert:* 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 15, 15E.

No. 31. MINE TIMBERS (*Cast in Place*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as STRUCTURAL MEMBERS.

III. CONSTRUCTION

Same as STRUCTURAL MEMBERS.

No. 32. MINE TIMBERS (*Precast*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as STRUCTURAL MEMBERS.

III. CONSTRUCTION

(a) Manufacture of

Same as PILES, PRECAST.

(b) Placing of

(To be supplied by the Engineer.)

No. 33. ORNAMENTAL PRODUCTS (*Wet Cast*).

I. GENERAL

Same as BLOCK, BUILDING, TAMPED.

II. MATERIALS

Same as BLOCK, BUILDING, TAMPED.

III. CONSTRUCTION

Same as BLOCK, BUILDING, WET CAST.

No. 34. ORNAMENTAL PRODUCTS, TAMPED.

I. GENERAL

Same as BLOCK, BUILDING, TAMPED.

II. MATERIALS

Same as BLOCK, BUILDING, TAMPED.

III. CONSTRUCTION

Same as BLOCK, BUILDING, TAMPED.

No. 35. PAVEMENTS, HIGHWAY (*One-Course*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 18C, 19, +19A, 19B, 20, 20A, +20B, 20C, 22, 22A, 22B, 22C, +22D, 22E, *22F, 22G, 23, 23B, 23C, 23D, *24, 24A, 24B, 25, 25A, +28, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 3, 3A, 4, 4A, 4B, 4C, 4D, +4E, 4F, 4G, 5, 5E, 6, 6A, 6B, 6C, 6D, 6E, 6F, 7, 7A, 7B, 7C, 7E, 8, 8B, 8C, 8D, *8G, 10, 10A, 10C, +10F, +10G, 10H, 13, 13E, 13F, 13G, 14, 14A, 14B, 14C, 14D, (14E, *if fabric is used*), 14G, 14H, 14I, (14J, *if fabric is used*), 14L, 15, 15E, 15G, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, 26, 26A, *26B, 26C, 26F, 26I, 26K, 27, 27A, *27B, 30, 30A, 33, 33C, 33D, 33E, 33F, 40, 40A, 41, 42, 42A, 42B, 42D, 43, 43A, 43C, 43D, 43E, 44, +44A, 44B, 45, 45A, 45E, 45F, 45K, 45N, 46, 46A, 46B, 55, 55A, +55B, +55K.

No. 36. PAVEMENTS, STREET (*One-Course*).

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *insert:* 11, 11D; and *omit:* 5, 5E.

No. 37. PAVEMENTS, STREET (*Two-Course*).

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *insert:* 11, 11D, (14F, *if fabric is used*), +18B, 21D, 21H, 26J, 32, 32A, 32B; and *omit:* 5E, 5, (14E, *if fabric is used*), 26I.

No. 38. PAVEMENTS, STREET (*One-Course*). With Integral Curb.

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* 19B, +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *insert:* 8E, 10D, 26L, 33H; and *omit:* 5, 5E, 8D.

No. 39. PAVEMENTS, STREET (*Two-Course*). With Integral Curb.

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* 19B, +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *insert:* 8E, 10D, +18B, 21D, 21H, 26J, 26L, 32, 32A, 32B, 33H; and *omit:* 5, 5E, 8D, 26I.

No. 40. PAVEMENTS, ALLEY (*One-Course*).

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* 5, 5E.

No. 41. PAVEMENTS, BARNYARD (*One-Course*).

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* (22, 22A, 22B, 22C, +22D, 22E, +22F *if no reinforcement is used*), 23D, +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* 5, 5E, 13G, (14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14I, 14J, 14L, 15, 15E, 15G, *if no reinforcement is used*), (261 *if no reinforcement is used*), 55A; and *insert:* +3C, (11, 11A, 11B, 11C, *if no reinforcement is used*),

No. 42. PAVEMENTS, BARNYARD (*Two-Course*).

I. GENERAL

Same as PAVEMENTS, HIGHWAY (One-Course).

II. MATERIALS

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* (22, 22A, 22B, 22C, +22D, 22E, +22F *if no reinforcement is used*), 23D, +28.

III. CONSTRUCTION

Same as PAVEMENTS, HIGHWAY (One-Course), except *omit:* 5, 5E, 13G, (14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14I, 14J, 14L, 15, 15E, 15G *if no reinforcement is used*), 26I, 55A. And *insert:* +3C, (11, 11A, 11B, 11C *if no reinforcement is used*), 21D, 21H, (26H *if no reinforcement is used*), (26J *if reinforcement is used*), 32, 32A, 32B.

No. 43. PIERS AND WHARVES.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 5, +5A, 5B, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13B, 13C, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14K, 14L, 15, 15A, 15B, 15C, 15F, *16, *17, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, 25B, 26, 26A, 26B, 26C, 26G, 26H, 26M, 27, 27A, 27B, 27C, 28, 28A, 28B, 28C, 28D, 28E, 29, 29A, 29B, 29C, 29D, +29E, 30, 30A, 30B, 31, 31A, 33, *33E, 33I, 40, *40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45J, 45K, +45L, *45N, 46, 46A, *47, +47A, (48 to 48F incl. *wherever necessary*), 48G, +49, 55, +55A, +55B, 55K.

CONSTRUCTION NOTES

In the construction of plain mass concrete structures in contact with sea water especial care should be taken to avoid the following: porous concrete, seams due to interruptions of work, and abrasion of the original surface.

Tests and investigations show that sea water does not injuriously affect piles or reinforced mass work of rich dense concrete when reinforcing is covered from 2 to 3 inches.

PILES

GENERAL NOTES

Concrete piles may be grouped according to the nature of the work for which they are designed or adapted, i. e., bearing piles, guide piles, fender piles and sheet piles.

In docks, piers, wharves and similar structures where a portion of the pile remains above firm surrounding soil it is subject to bending strains in addition to vertical loads. Precast, reinforced concrete piles, designed for such conditions will usually be required.

Local soil conditions affect the choice of type of pile.

Cast in place piles are well suited to soils having compressibility together with sufficient stability to prevent damage to the soft concrete after placing, to form the pile. Elastic soils, sand or gravel may under certain conditions react against the soft concrete when the forms are removed. Under these conditions a precast pile should be used.

Fresh cast-in-place piles may be protected from injury due to driving of forms for adjacent piles by driving forms of alternate piles the first time over, completing the number of piles on the return trip.

No. 44. PILES (*Cast in Place*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17B, 19, +19A, 21, 21A, +21B, 22, 22A, 22B, 22C, 22E, *22F, 22G, 22H, +22J.

III. CONSTRUCTION

1, 6, 6A, 6B, 6C, 6D, 6F, 7, 7E, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14L, 15, 15E, 15F, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, *26C, 27, 27A, *27B, 28, 28A, 28C, 43, 43C, 43D, 43E, 55, +55B, +55K.

No. 45. PILES (*Precast*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as PILES (Cast in Place).

III. CONSTRUCTION

(a) Manufacture of

Same as PILES (Cast in Place), except *insert:* 41, 45, 45A, 45B, 45C, 45D, 45E, 45G, 45H, 45I; and *omit:* *16, *17, 28, 28A, 28C, 43, 43C, 43D, 43E.

(b) Driving Piles

29, 29A, 29B, 29C, 29D, 29E.

No. 46. PIPE, SEWER.

I. GENERAL

+1, +2.

II. MATERIALS

Manufacture of Pipe.

1 to 5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, 22J, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

(a) Manufacture of Pipe

1, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, +7J, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, 26, *26C, 27B, 30, 30A, 30B, 41, 45, 45B, 45C, 45D, 45E, 45G, 45H, 45I, 55, 55A, +55B, 55C, +55D (Use A. S. T. M.), 55G, +55K, (*Where tests of completed units are impossible, use:* 24, 24A, 24C).

(b) Laying of Sewer Pipe

52, 52A, 52B, 52C, 52D, +52E, 52F, 52G, 52H, 52I.

No. 47. PIPE, WATER (*Manufacture of*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as PIPE, SEWER.

III. CONSTRUCTION

(a) Manufacture of.

Same as PIPE, SEWER.

(b) Laying Pipe.

(To be supplied by Engineer).

No. 48. POLES, ELECTRIC TRANSMISSION (*Precast*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as PILES (Precast).

III. CONSTRUCTION

Same as PILES (Precast), Manufacture of.

No. 49. POLES, ELECTRIC TRANSMISSION, TOWERS (*Cast in Place*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, 22H, +22J, *24, 24A, 24B, 25, 25A.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8G, 13, 13A, 13B, 13C, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14K, 15, 15A, 15E, 15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 28, 28A, 28C, 28D, 28E, (29 to 29E incl. *if necessary*), 30, 30A, 30B, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, 48G, 55, +55B, +55K.

No. 50. POLES, ELECTRIC LIGHTING (*Precast*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as POLES, ELECTRIC TRANSMISSION (Precast), except *insert:* 12, +12A, +12B.

III. CONSTRUCTION

Same as POLES, ELECTRIC TRANSMISSION (Precast), except *insert:* 37, 37A, 37C, 38, +38A, (*Use* 38B, 38C, 38D, 38E, 38F *or* 38G).

No. 51. POSTS, FENCE (*Manufacture of*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as POLES, ELECTRIC LIGHTING.

III. CONSTRUCTION

Same as POLES, ELECTRIC LIGHTING.

No. 52. RESERVOIRS, OIL.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 4, 4A, 4B, 4F, 5, 5B, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8F, 8G, 10, *10A, 12, 12A, 12B, 13, 13A, 13B, 13C, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 15, 15A, 15B, 15E, 15F, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26D, 26G, *26K, 26M, 27, 27A, 27B, 27C, (29 to 29E incl. *if necessary*), 30, 30A, 30B, 33, 33E, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, 44C, 45, 45A, 45E, 45F, +45L, 45M, 45N, 46, 46A, *47, +47A, (48 to 48F incl. *if membrane is used*), 48G, 50, *50A, 55, +55A, +55B, 55J, +55K.

No. 53. RESERVOIRS, WATER.

I. GENERAL

+1, +2.

II. MATERIALS

Same as RESERVOIRS, OIL.

III. CONSTRUCTION

Same as RESERVOIRS, OIL, except *omit:* 50, 50A.

No. 54. STAIRS.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl., (*except* 4G), 7, 7A, 7C, 7D, 8, 8A, 8B, 11, 12, +12A, +12B, 13, 13A, 15, 15A, +15B, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, *22H, +22J, *24, 24A, 24B.

III. CONSTRUCTION

1, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8G, 13, 13A, 13C, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15B, 15C, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 30, 30A, 30B, 32, 32A, 32B, (32C *or* 32D), 33, (33A *or* 33B), 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45J, 46, 46A, 55, +55A, +55B, +55K.

No. 55. STUCCO, PORTLAND CEMENT.

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4G, 4H, 11, 12, +12A, +12B, 13, 13A, 14, 14A, 15, 15A, +15B, 16, 16A, *24, 24A, 24B, 25, 25A, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 27D.

III. CONSTRUCTION

1, 6, 6A, 6B, 6C, 6D, 6F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 20, 20A, 20B, 20C, 20D, 20E, 20F, 21, 21A, 21B, 21D, 21E, 21F, 21H, 22, 23, 25, 25A, 26, 26A, 27, 27A, 34, 34A, 34B, 34C, 34D, 34E, 34F, 34G, 35, 35A, 35B, 35C, 35D, 36, 36A, 36B, 36C, 36D, 36E, 36F, 36G, 36H, 38, 38A, (*Use* 38B, 38H, 38I, 38J, 38K, *or* 38L), 41, 42, 42A, 43, 43A, 43B, 43C, 43D, 43E, +44, *47, +47A, 48G, +49, 55, +55A, +55B, +55K.

No. 56. SUBWAYS (*Under Passes, Etc.*).

I. GENERAL

+1, +2.

II. MATERIALS

1 to 5 incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 9, 9A, 9B, 11, 12, +12A, +12B, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, *22H, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 4, 4A, 4B, 4F, 5, +5A, 5C, 5D, 6 to 7C incl. (*except* 6E), 7E, 7F, 7G, 7H, 8, 8A, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13B, 13C, 13D, 13E, 13F, 13G, 13H, 14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14I, 14J, 14L, 15, 15A, 15B, 15C, 15D, 15E, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26G, 26I, 26K, 26M, 26N, 27, 27A, 27B, 27C, (*Use* 29 to 29E incl. *when necessary*), 30, 30A, 30B, 31, 31A, 33, 33E, 33I, 40, 40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, +44A, 45, 45A, 45E, 45F, 45J, 45K, +45L, 45N, 46, 46A, 46B, *47, +47A, (48 to 48F incl. *if necessary*), 48G, +49, 55, +55A, +55B, +55K.

No. 57. SWIMMING POOLS.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5D incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 12, +12A, +12B, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 18C, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, 2E, 3, 3A, 3C, 4, 4A, 4B, 4F, 5, 5B, 5D, 6 to 7C incl. (*except* 6E), 7E, 7F, 7H, 8, 8A, 8G, 10, 10A, 12, 12A, 12B, 13, 13A, 13D, 13E, 13H, 14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14J, 15, 15A, 15E, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26G, *26K, 26M, 27, 27A, 27B, 27C, 30, 30A, 30B, 31, 31A, 33, *33E, 40, *40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 44C, 45, 45A, 45E, 45F, +45L, 46, 46A, *47, +47A, 48G, +49, 55, 55A, +55B, 55J, +55K.

No. 58. TANKS, BRINE.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 4, 4A, 4B, +4E, 4F, 5, 5B, 5D, 6 to 7C incl. (*except* 6E), 7E, 7F, 7H, 8, 8A, 8G, 13, 13A, +13D, 13H, 14, 14A, 14B, 14C, 14D, 14E, 14G, 14H, 14J, 15, 15A, 15E, *15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26D, 26G, 26M, 27, 27A, 27B, 27C, 30, 30A, 30B, 33, *33E, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, 44C, 45, 45A, 45E, 45L, 45M, 46, 46A, *47, +47A, (48 to 48E *if membrane is used*), 48G, +49, 55, +55B, 55J, +55K.

No. 59. TANKS, FUEL OIL (*Lighter than* 35° *Baume*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as TANKS, BRINE.

III. CONSTRUCTION

Same as TANKS, BRINE, except *insert:* 13B, 15B, (*Use* 29 to 29E incl. *when necessary*), 50, *50A.

No. 60. TANKS, SEPTIC.

I. GENERAL

+1, +2.

II. MATERIALS

Same as TANKS, FUEL OIL.

III. CONSTRUCTION

Same as TANKS, FUEL OIL, except *omit:* 15B, 50, *50A.

No. 61. TANKS, SPECIAL.

(For certain vegetable and animal oils and strong acids.)

I. GENERAL

+1, +2.

II. MATERIALS

Same as TANKS, FUEL OIL.

III. CONSTRUCTION

Same as TANKS, FUEL OIL.

(*Note to Architect or Engineer:* Special reference should be made to paragraphs 50, 50A and the table in the Appendix 2, "Effect of Oils and Miscellaneous Liquids on Concrete and Method of Protective Treatment Where Required.")

No. 62. TANKS, WATER.

I. GENERAL

+1, +2.

II. MATERIALS

Same as TANKS, FUEL OIL.

III. CONSTRUCTION

Same as TANKS, FUEL OIL, except *omit:* 15B, 50, *50A.

No. 63. TENNIS COURTS.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl. (*except* 4G), 7, 7A, 7C, 7D, 7E, 8, 8A, 8B, 11, 13, 13A, 15, 15A, +15B, 17, 17A, 18, 18A, 18B, 18C, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, 3, 3C, 4, 4A, 4B, 4E, 4F, 5, *5E, 6, 6A, 6B, 6D, 6F, 7, 7A, 7B, 7C, 7E, 8, 8B, 8C, 8D, 10, 10A, 10C, (11, 11A, 11C, *if no reinforcement is used*), 14, 14A, 14B, 14C, 14D, 14E, 14F, 14G, 14H, 14J, 15, 15G, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 20C, 20D, 20E, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, 26, 26A, 26B, 26C, 26J, *26K, 27, 27A, 30, 30A, 32, 32A, 32B, 33, *33E, 33G, 40, *40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, 45F, 45K, 46, 46A, *47, +47A, 55, +55B.

No. 64. TILE, BUILDING.

I. GENERAL

Same as BLOCK, BUILDING.

II. MATERIALS

Same as BLOCK, BUILDING.

III. CONSTRUCTION

(a) Manufacture of

Same as BLOCK, BUILDING.

(b) Laying of

Same as BLOCK, BUILDING.

No. 65. TILE, DRAIN.

I. GENERAL

Same as PIPE, SEWER.

II. MATERIALS

Same as PIPE, SEWER.

III. CONSTRUCTION

(a) Manufacture of

Same as PIPE, SEWER.

(b) Laying of

51, 51A, 51B, 51C, 51D, 51E.

No. 66. TRIMSTONE (*Concrete*).

I. GENERAL

Same as BLOCK, BUILDING, and BRICK.

II. MATERIALS

Same as BLOCK, BUILDING, and BRICK.

III. CONSTRUCTION

(a) Manufacturer of

(Note to Architect or Engineer: Refer to *Concrete Block, Building [Tamped]; Block, Building [Wet Cast]* and *Brick [Tamped].)*

(b) Setting of

39, 39A, 39B, +39C, 39D, 39E, +39F, 39G, 39H, 39I.

No. 67. TUNNELS.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 3, 3A, 3B, 5, 5B, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7G, 7H, 8, 8A, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13B, 13C, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 14L, 15, 15A, 15B, 15C, 15D, 15E, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26D, 26M, 27, 27A, 27B, 27C, 30, 30A, 30B, 31, 31A, 41, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, (48 to 48F incl. *if membrane is used*), 48G, +49, 55, +55B, +55K.

No. 68. VAULTS, BANK.

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, 22H, +22J, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, 3, 3A, 5, +5A, 5D, 6 to 7C incl. (*except* 6E), 7E, 7F, 7H, 8, 8A, 8G, 13, 13A, 13B, 13C, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 15, 15A, 15H, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, 26, 26A, 26B, 26C, 27, 27A, 27B, 30, 30A, 30B, 41, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, (48 to 48F incl. *if membrane is used*), 48G, +49, 55, +55B, +55K.

No. 69. VAULTS, BURIAL (*Mausoleum*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 12, +12A, +12B, 13, 13A, 15, 15A, +15B, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, +22J, 24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 5, +5A, 5D, 6, 6A, 6B, 6C, 6D, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7H, 8, 8A, 8G, 13, 13A, 13B, 13C, 13H, 14, 14A, 14B, 14C, 14D, 14E, 14F, 14G, 14H, 14J, 15, 15A, 15E, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 20C, 20D, 20E, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24B, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26D, 26M, 27, 27A, 27B, 27C, (29 to 29E incl. *if necessary*), 30, 30A, 30B, 31, 31A, 37, 37A, 37B, 37C, 38, 38A, (*Use* 38B, 38C, 38D, 38E, 38F, *or* 38G), 39, 39A, 39B, 39C, 39D, 39E, 39F, 39G, 39H, 39I, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, (48 to 48F incl. *if membrane is used*), 48G, +49, 55, +55A, +55B, +55K.

(*Note to Architect:* For paragraphs on floors see Floor Specifications [Nos. 18 to 23 incl.].)

No. 70. WALKS (*One-Course*).

I. GENERAL

+1, +2.

II. MATERIALS

1 to 5B incl. (*except* 4G), 7, 7A, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 18, 18A, 18B, 18D, 19, +19A, 20, 20A, +20B, 23, 23A, *24, 24A, 24B, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, 3, *3A, 3D, 4, 4A, 4B, *4D, 4F, 5, 5E, 6 to 7B incl., 7E, 8, 8B, 8C, 8D, 10, 10A, 10B, 10E, 11, 11A, 11C, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, 26, 26A, 26B, 26C, 26F, *26K, 27, 27A, 30, 30A, 33, *33E, 33G, 38, 38A, (*Use* 38B, 38C, 38D, *or* 38G), 40, *40A, 41, 42, 42A, 42B, 42C, 42D, 43, 43A, 43C, 43D, 43E, 44, *44A, 44B, 45, 45A, 45E, 45F, 45K, 46, 46A, *47, +47A, 55, 55A, +55B.

No. 71. WALKS (*Two-Course*).

I. GENERAL

+1, +2.

II. MATERIALS

Same as WALKS (One-Course), except *insert:* 12, +12A, +12B, 15, 15A, +15B.

III. CONSTRUCTION

Same as WALKS (One-Course), except *insert:* 20C, 20D, 20E, 21D, 21H, 26H, 32, 32A, 32B, and *omit:* 26F.

No. 72. WALLS, ABUTMENT (*With Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1 to 5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25B, +25C.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 5, +5A, 5D, 6 to 7C incl. (*except* 6E), 7E, 8, 8A, 8G, 13, 13A, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 15, 15A, 15E, 15F, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26M, 27, 27A, 27B, 27C, (29 to 29E incl. *if necessary*), 30, 30A, 30B, 38, 38A, (*Use* 38B, 38C, 38D, 38E, 38F, *or* 38G), 41, 42, 42A, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, +45L, *47, +47A, (*Use* 48 to 48F incl. *if necessary*), 48G, +49, 55, 55A, +55B, +55K.

No. 73. WALLS, BASEMENT. Resisting Water Pressure. (*Including Floor Slab.*)

I. GENERAL

+1, +2.

II. MATERIALS

1 to +5B incl. (*except* 4G), 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, 23, 23A, *24, 24A, 24B, 25, 25A, +25B, +25C, 29, +29A, +29B.

III. CONSTRUCTION

1, 2, 2A, +2B, 2C, 2D, 2E, 3, 3A, 3B, 3C, 4, 4A, 4B, +4E, 4F, 5, 5B, 5D, 6 to 7C incl. (*except* 6E), 7E, 8, 8A, 8G, 10, 10A, 10J, 12, 12A, 12B, 13, 13A, 13D, 13H, 14, 14A, 14B, 14C, 14D, 14E, 14F, 14G, 14H, 14J, 15, 15A, 15D, 15E, *16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26G, 26H, 27, 27A, 27B, 27C, (*Use* 29 to 29E incl. *if necessary*), 30, 30A, 30B, 31, 31A, 32, 32A, 32B, 41, 42, 42A, 42C, 42D, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, 45F, 45J, +45L, 46, 46A, *47, +47A, 48, +48A, 48B, 48C, 48D, 48E, 48F, 48G, +49, 55, 55A, +55B, +55K.

No. 74. WALLS, BASEMENT, ORDINARY (*No Reinforcement*).

I. GENERAL

+1, +2.

II. MATERIALS

1 to 5B incl. (*except* 4G), 7, 7A, 7B, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

1, 2, 2A, 2E, 3, 3A, 3C, 5, +5A, 5D, 6 to 7C incl. (*except* 6E), 7E, 8, 8A, 8G, 13, 13A, 13H, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, 27B, 27C, 30, 30A, 30B, 31, 31A, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, +44, 45, 45A, 45E, +45L, 48G, +49, 55, 55A, +55B.

No. 75. WALLS, CURTAIN.

I. GENERAL

+1, +2.

II. MATERIALS

1 to 8B incl. (*except* 4G), 1, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

1, 6 to 7C incl. (*except* 6E), 7E, 8, 8A, 8F, 8G, 13, 13A, 13H, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14J, 15, 15A, 15B, 15C, 15D, *16, *17, 18, +18A, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 26M, 27, 27A, 27B, 27C, 30, 30A, 30B, 41, 42, 42A, 43, 43A, 43C, 43D, 43E, 45, 45A, 45E, +45L, *47, +47A, 48G, +49, 55, 55A, +55B, +55K.

No. 76. WALLS, FIRE.

I. GENERAL

+1, +2.

II. MATERIALS

Same as WALLS, CURTAIN, except *omit:* 6, 6A, 6B, 6C.

III. CONSTRUCTION

Same as WALLS, CURTAIN.

No. 77. WALLS, PARAPET.

I. GENERAL

+1, +2.

II. MATERIALS

Same as WALLS, CURTAIN.

III. CONSTRUCTION

Same as WALLS, CURTAIN.

No. 78. WALLS, PIT.

I. GENERAL

+1, +2.

II. MATERIALS

Same as WALLS, BASEMENT, (resisting water pressure).

III. CONSTRUCTION

Same as WALLS, BASEMENT, (resisting water pressure).

No. 79. WALLS, RETAINING (*Large, Gravity*).

I. GENERAL

+1, +2.

II. MATERIALS

See DAMS, GRAVITY.

III. CONSTRUCTION

See DAMS, GRAVITY and FOUNDATIONS, heavy, (with vibration).

No. 80. WALLS, RETAINING (*Small, Gravity*).

I. GENERAL

+1, +2.

II. MATERIALS

See WALLS, BASEMENT, ORDINARY and FOUNDATIONS, SMALL, with light loads (no reinforcement).

III. CONSTRUCTION

See WALLS, BASEMENT, ORDINARY and FOUNDATIONS, SMALL, with light loads (no reinforcement).

No. 81. WALLS, RETAINING (*Reinforced*).

I. GENERAL

+1, +2.

II. MATERIALS

See FOUNDATIONS, HEAVY (with reinforcement) and WALLS, ABUTMENT.

III. CONSTRUCTION

See FOUNDATIONS, HEAVY (with reinforcement) and WALLS, ABUTMENT.

No. 82. STRUCTURAL MEMBERS (*Columns, Beams, Girders, Etc.*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, 5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 13, 13A, 17, 17A, 17B, 18, 18A, 18B, 19, +19A, 20, 20A, +20B, 21, 21A, +21B, 21C, 21D, +21E, +21F, 21G, 22, 22A, 22B, 22C, 22E, *22F, 22G, 22H, 22I, +22J, *24, 24A, 24B, 25, 25A.

III. CONSTRUCTION

1, 6, 6A, 6B, 6C, 6D, 6E, 6F, 7, 7A, 7B, 7C, 7E, 7F, 7H, 8, 8A, 8G, 9, 9A, +9B, +9C, +9D, +9E, 13, 13A, 13B, 13C, 14, 14A, 14B, 14C, 14D, 14G, 14H, 14K, 14L, 15, 15B, 15C, 15D, 15E, 16, *17, 18, +18A, +18B, 19, *19A, *19B, 19C, 19D, *19E, 19F, 19G, 19H, 19I, 19J, 20, 20A, 21, 21A, 21B, 21C, 21E, 21F, 21G, 22, 23, 24, 24A, 24B, 24C, 25, 25A, *25B, 26, 26A, 26B, 26C, 27, 27A, 27B, 30, 30A, 30B, 38, +38A, (*Use* 38B, 38C, 38D, 38E, 38F *or* 38G), 41, 42, 42A, 43, 43A, 43B, 43C, 43D, 43E, +44, 45, 45A, 45E, +45L, *47, +47A, 48G, 50, *50A, 55, 55A, +55B, +55K.

No. 83. ROOFING TILE (*Large*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, 3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 5, 5A, +5B, 7, 7A, 7B, 7C, 7D, 8, 8A, 8B, 11, 12, +12A, 13, 13A, 15, 15A, +15B, 22, 22A, 22B, 22C, 22E, *22F, 22G, +22J, *24, 24A, 24B, 25, 25A.

III. CONSTRUCTION

(a) Manufacture of Tile

(*Note to Architect or Engineer:* Consult Manufacturers' Specifications.)

(b) Laying of Tile

53, 53A, 53C, 53E, 53F.

No. 84. ROOFING TILE (*Small*).

I. GENERAL

+1, +2.

II. MATERIALS

1, 2, 2A, 3, *3A, 3B, 3C, 4, 4A, 4B, 4C, 4D, 4E, 4F, 4H, 12, +12A, 13, 13A, 15, 15A, *24, 24A, 24B, 25, 25A, +25C.

III. CONSTRUCTION

(a) Manufacture of Tile

(*Note to Architect or Engineer:* Consult Manufacturers' Specifications.)

(b) Laying of Tile

53, 53A, 53B, 53D, 53F.

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